UAV TACTICAL CONTROL SYSTEM
MISSION PLANNER

SOFTWARE USER'S MANUAL

CONTRACT NO. N00178-97-C-2029
CDRL SEQUENCE NO. A006

05 January 1998

Prepared for:

Naval Surface Warfare Center
Dahlgren Division
17320 Dahlgren Road
Dahlgren, VA 22448-5100

Prepared by:

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LOGICON

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UAV TCS Program Manager

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1. INTRODUCTION

This Software User's Manual (SUM) applies to the Computer Software Configuration Item (CSCI) identified as the Unmanned Aerial Vehicle Tactical Control System (UAV TCS) Mission Planner (hereinafter referred to as the Planner). The SUM describes all of the Planner menus and dialogs.

The Planner is a mission data preparation system for existing and future unmanned aerial vehicles (AV). Mission planning includes AV flight operations and payload operations. A mission plan consists of waypoints and flight segments between waypoints. A waypoint consists of coordinates, altitude, and airspeed. Payload actions (payload pointing commands) may be specified for a waypoint. A flight corridor is a defined region about the flight route which allows for deviations in the flight path.

The SUM is organized in six parts: part 1, Introduction, describes the Planner and SUM organization; Part 2, Graphical User Interface (GUI), describes the GUI, menu and dialog conventions; Part 3, Mouse Functions, explains how to select and control objects on the screen using a mouse; Part 4 describes each menu and subsequent data edit and data view dialogs; Part 5 is a list of acronyms and their definitions, and Part 6 is an index of key words and the page numbers where they can be found.

The Planner is operational on the TAC-4 (Hewlett Packard HP9000/J210 with 320 MB of memory) with the HP-UX 10.20 operating system, and on the CHS-II (SUN Sparc 20 Model 152 MP with 256 MB of memory) with the Solaris 2.5.1 operating system.

2. GRAPHICAL USER INTERFACE (GUI)

2.1 Introduction and Execution

The UAV TCS Mission Planner is called as a stand alone process on the Sun or HP. The Planner interfaces with UAV TCS and uses Joint Mapping Tool Kit (JMTK) for graphical displays. The user invokes the UAV TCS Mission Planner by selecting Mission Planner from the TCS. The Planner attempts to connect to an existing JMTK process, otherwise a new JMTK process is started to which the Planner connects. The Mission Planner Toolbar window and the Drawing Area window (JMTK window) are displayed. To make a window the active window, click on the border of the window.

2.2 Main Toolbar

The Planner Toolbar consists of pull-down menus, pull-right menus, hot buttons, router status button and a message area (see Figure 2.2-1).

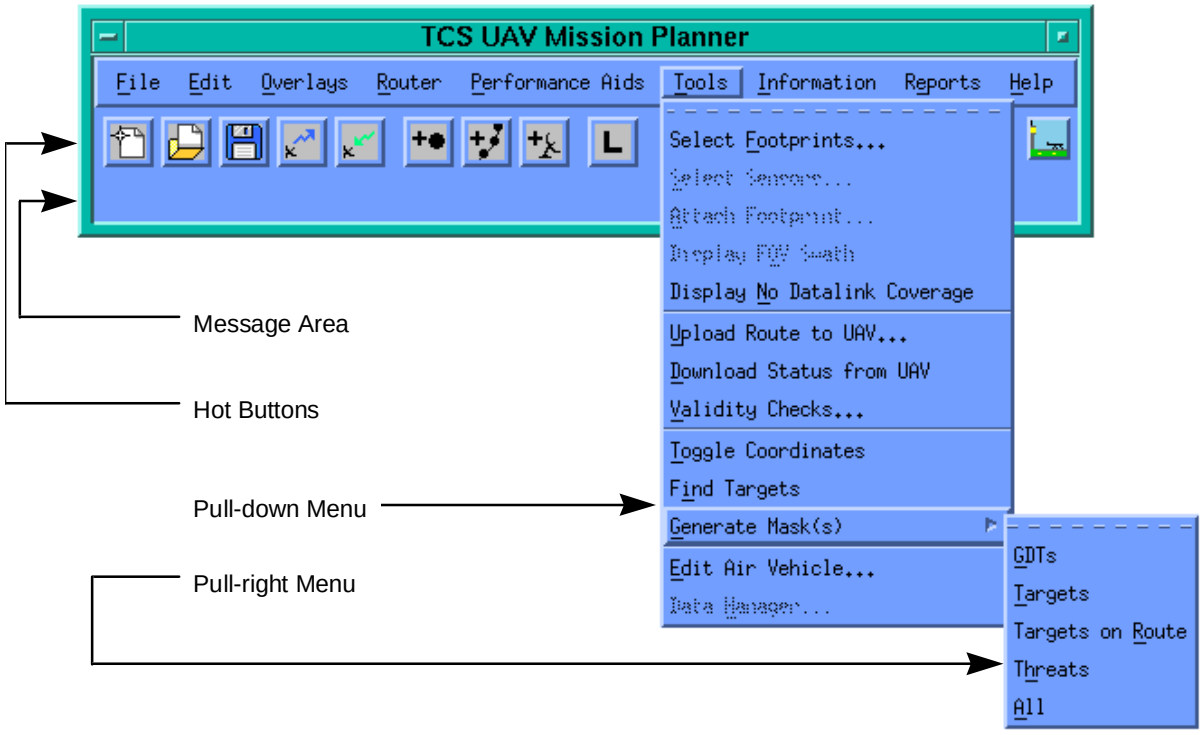

Figure 2.2-1

2.3 Pull-down Menus

The menu title buttons across the top of the toolbar are the pull-down menu selections. To display a pull-down menu, position the pointer on the appropriate menu title button and click the left mouse button. Subsequent choices are made from the displayed pull-down menu. To remove the pull-down menu without making a selection, position the pointer off the menu and click the left mouse button. To open a pull-down menu and choose an item on the menu in a

single motion, position the pointer on the desired menu title, press the left mouse button, and drag the pointer down the displayed menu to the desired item before releasing the mouse button. If a menu title or pull-down menu item is not active, it will appear desensitized (light gray) on the screen and can not be selected. Tear off menus are supported for all pull-down menus. Click on the dashed line on a pull-down menu to place the menu onto a window that will remain displayed. This allows the user to make a toolbar out of any menu.

2.4 Pull-right Menus

Certain options on the pull-down menus use additional menus, displayed to the right of the pull-down menu. To display a pull-right menu, position the pointer on the appropriate pull-down option and click the left mouse button. Subsequent choices are made from the displayed pull-right menu.

2.5 Hot Buttons

The commands in the hot button row of the toolbar window represent the most often used pull-down menu items (see Figure 2.2-1). A hot button allows you to execute a multiple step process in a single click. To execute one of the hot button commands, position the pointer on the desired hot button and click the left mouse button. Every hot button has an equivalent path using the pull-down menus. The hot buttons from left to right are: New Route, Open Route, Save Route, Upload to UAV, Download from UAV, Insert Point, Import Segment, Add/Delete Ground Data Terminal (GDT) to Route, and Toggle Coordinates.

2.6 Message Area and Router Status.

The message area is used to clarify mouse button functions as they apply to the active command and to provide information, warning, and error messages. In addition to the message area, the user is provided with information, warning, and error messages in dialog boxes that appear in the drawing area. On the right side of the toolbar is the router status button. When the router is running the button will be animated, and when the router is not running the button will be static.

2.7 Drawing Area (Main Window, JMTK Window).

The drawing area window displays the routes and background information specified by the user. The routes displayed on the drawing area use symbols and colors to distinguish between route point types and segment types. Any time a route point is designated by the user (see Mouse Functions in next section), the associated route point number is displayed. The route point numbers correspond to the route point numbers used in the flight plan and evaluation reports.

3. MOUSE FUNCTIONS

The mouse, along with the keyboard, comprise the primary user interface to the Planner. The mouse is the hardware device which can be moved over a flat horizontal surface to maneuver the pointer icon displayed on the screen. The mouse has three buttons used to initiate action.

3.1 Pointer Movements

The pointer is the mobile screen icon usually represented by a small arrow. The pointer is used to indicate what area of the screen is to be active or where an action is to be directed. The pointer is moved around the screen by two dimensional motion of the mouse about the physical desktop.

3.2 Mouse Buttons

Mice have one, two or three buttons. The Mission Planner uses a three button mouse (left, middle and right).

Each button provides a different capability (including none) depending on the area of the screen in which the pointer is located.

3.3 Click

A click is the basic activation of any mouse button consisting of press and release. The result of a click could be highlight, open, select, move or other depending upon the button that was used and the location of the pointer icon on the screen. In this document, press, push, hit, and select in reference to a GUI object means click. Within a dialog using the keyboard 'Enter' key is equivalent to clicking a highlighted button. A click event can also be modified by holding down a key. Currently the Mission Planner only supports shift-click. A variation of click is drag which is a prolonged click in which the mouse is moved while the button is held down and released at another location.

3.4 Double Click

Double click is a special extension of click for added functionality. Double click is accomplished by doing a press and release twice in rapid succession (the double click speed is software adjustable). Double click is usually applied using the left mouse button to activate a function.

3.5 Mission Planner Mouse Conventions

A route point is selected by placing the mouse pointer over the route point and clicking the left mouse button.

A route segment is selected by selecting a route point to begin the segment. Then place the mouse pointer over the route point to end the segment and click with the left mouse button while depressing the <Shift> key.

To clear point designations, position the pointer over the active Main Window and press the <Escape> key.

The route point edit dialog can be displayed by double clicking on the desired point with the left mouse button.

Dragging a line (generate a SAR image strip, for example) is accomplished by depressing the left mouse button, holding it down while the mouse is moved, and then releasing the button.

4. PULL-DOWN MENU FUNCTIONS

4.1 File Pull-down Menu

The File menu is used to create, delete, open, close, and display routes or route segments.

4.1.1 New Route

4.1.1.1 Purpose. The File menu, New Route function allows the user to enter into an interactive mission planning session for a new route.

4.1.1.2 Execution. To create a new route, execute the New Route function on the File pull-down menu, Figure 4.1.1.2-1. Airbase symbols are displayed in the drawing area and the message area displays a prompt to pick an airbase or location for the launch point. After the user selects the airbase or location by clicking on the area with the left mouse button, a prompt is displayed to pick an airbase or location for the landing point.

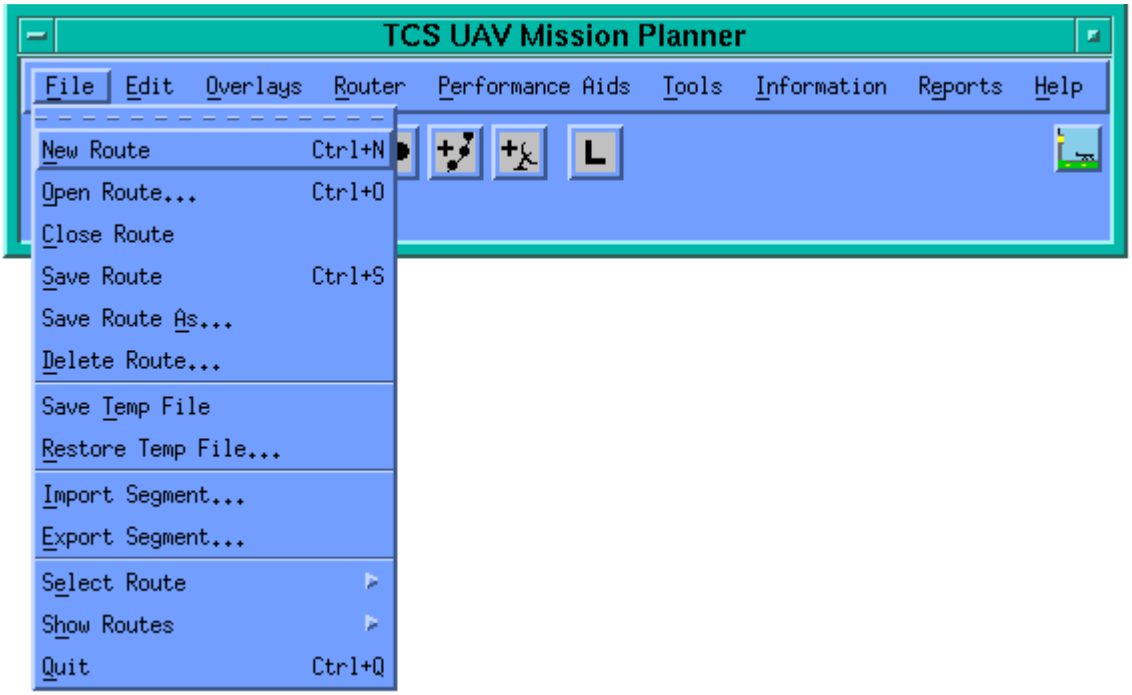

Figure 4.1.1.2-1

After the landing point is selected, the airbase symbols display is removed and the Edit Mission Parameters dialog, Figure 4.1.1.2-2, is displayed. The user may enter new mission values, or accept the displayed default values. The 'Ok' button may be selected to use the mission parameters, or the 'Cancel' button may be selected to cancel the function and returned to the state prior to selecting the New Route menu option. See page 33 for a description of the Mission Parameters dialog.

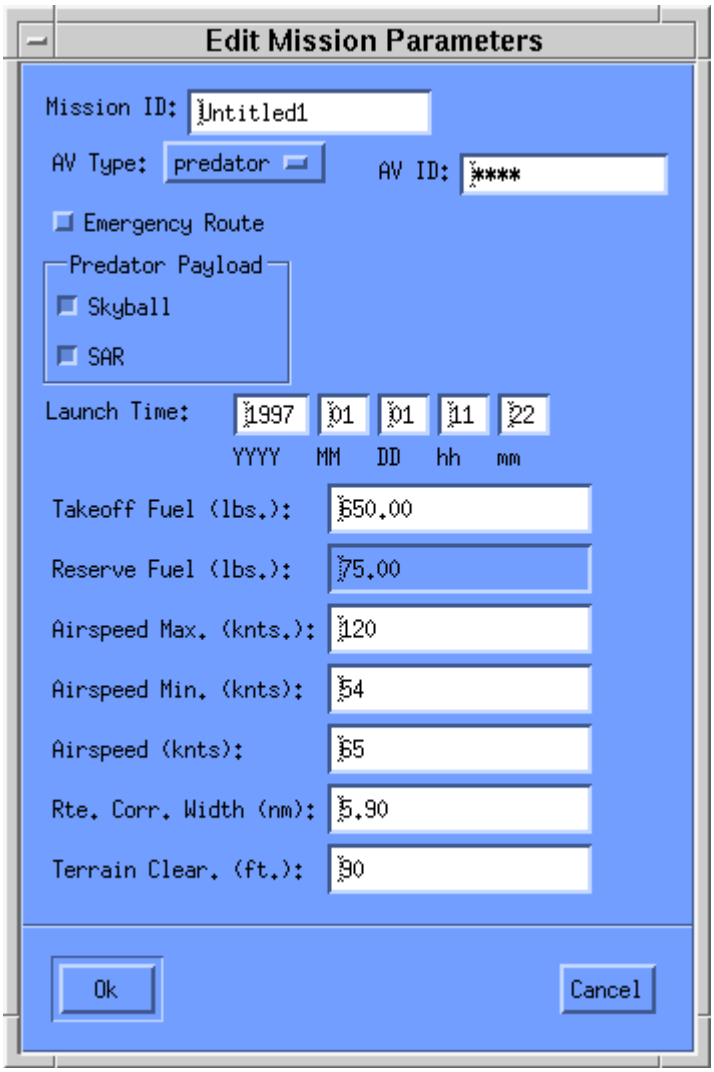

Figure 4.1.1.2-2

4.1.1.3 Results. Upon executing the New Route function, the new route launch and landing points are displayed on the drawing area, separated with a dashed connecting line.

4.1.2 Open Route.

4.1.2.1 Purpose. The File menu, Open Route function allows the user to select an existing route file to be loaded into the Planner. More than one route may be loaded into the Planner, however, only one route is active and editable by the user. This function provides the user with a list of existing route files from which to choose.

4.1.2.2 Execution. To open an existing route, execute the Open Route function on the File pull-down menu. The Open Route dialog, Figure 4.1.2.2-1 is displayed. This dialog contains a scrolled list of route files. The 'Cancel' button returns the user to the Planner toolbar with no action taken. To select a route, the user highlights the desired route file and clicks on the 'OK' button. Due to Common Operating Environment (COE) requirements, the user may not change directories.

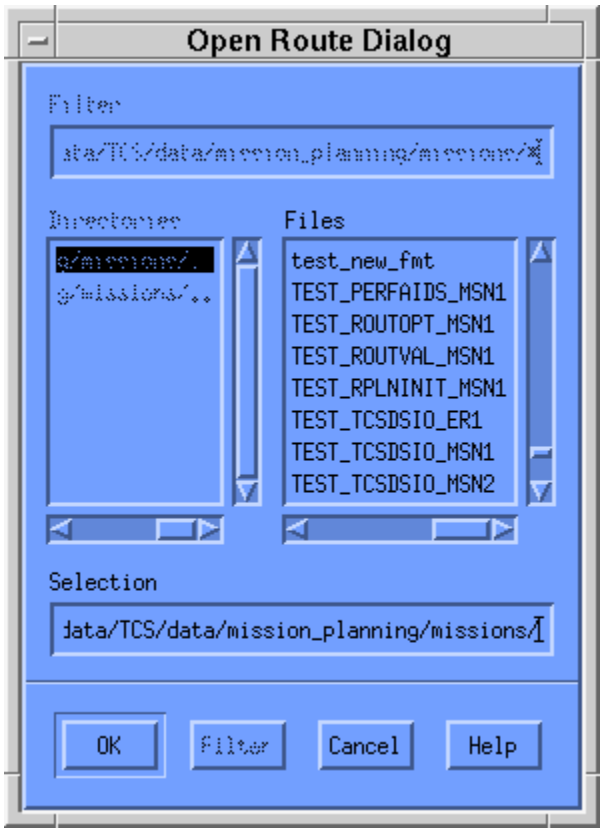

Figure 4.1.2.2-1

4.1.2.3 Results. Upon executing the Open Route function, the selected route points are loaded into the Planner and displayed, and become the active route.

4.1.3 Close Route.

4.1.3.1 Purpose. The File menu, Close Route function allows the user to unload a route from the Planner and remove the display of the route points.

4.1.3.2 Execution. To close the active route, execute the Close Route function on the File pull-down menu. When the route is new or has been modified and has not been saved, the Save Changes dialog, Figure 4.1.3.2-1, is displayed. Selecting the 'Cancel' button returns the user to the Planner toolbar with no action taken. Selecting the 'No' button closes the route without saving any changes. Selecting the 'Yes' button saves the route to disk and then closes it.

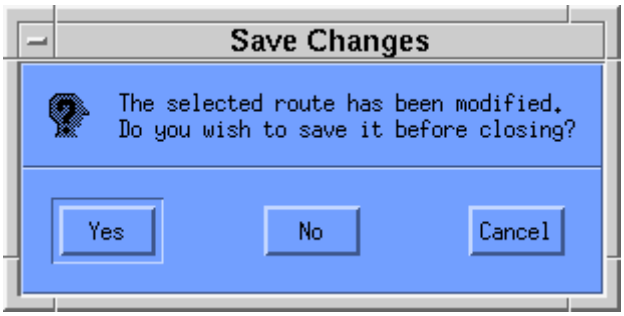

Figure 4.1.3.2-1

4.1.3.3 Results. The active route is removed from the display and is also removed from the computer memory (the route file remains available on the computer disk). All other routes remain displayed. The route opened immediately prior to the closed route now becomes active. When no prior route exists, then the route that was opened immediately after the closed route becomes active.

4.1.4 Save Route.

4.1.4.1 Purpose. The File menu, Save Route function is used to permanently save a route to disk.

4.1.4.2 Execution. To save a route to disk, execute the Save Route function on the File pull-down menu, Figure 4.1.4.2-1. The route will be saved and remains active on the screen for further edits.

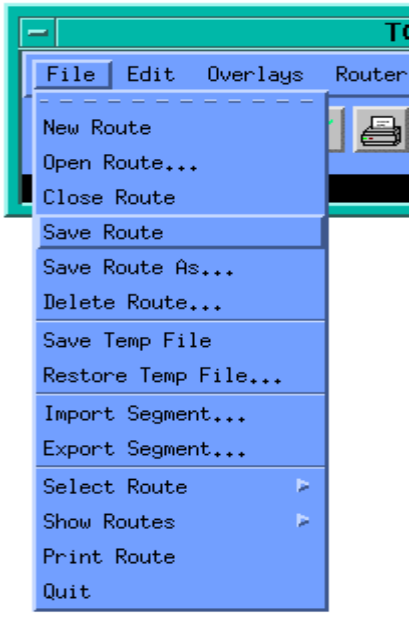

Figure 4.1.4.2-1

4.1.4.3 Results. Save Route produces a text file on the disk 'mission directory' consisting of the route data, including mission parameters.

4.1.5 Save Route As

4.1.5.1 Purpose. The File menu, Save Route As function allows the user to save an existing route to disk with another route name.

4.1.5.2 Execution. To save the active route with another name, execute the Save Route As function from the File pull-down menu. The Save Route As dialog, Figure 4.1.5.2-1, is displayed with a scrolled list of the existing routes and a route name data entry field. The user may select a route name from the list or enter a name to the data entry field. When an existing route name is selected, the existing route file is over-written with the active route. **Caution**: no over-write message or confirmation dialog is displayed. When the 'OK' button is selected, the route is saved and the dialog is closed. All Planner references to the route are changed to the new name, for example, the File menu Select Route function now displays the new name of the route. When the 'Cancel' button is selected, the dialog is closed without saving the route. Due to COE requirements the user may not change directories.

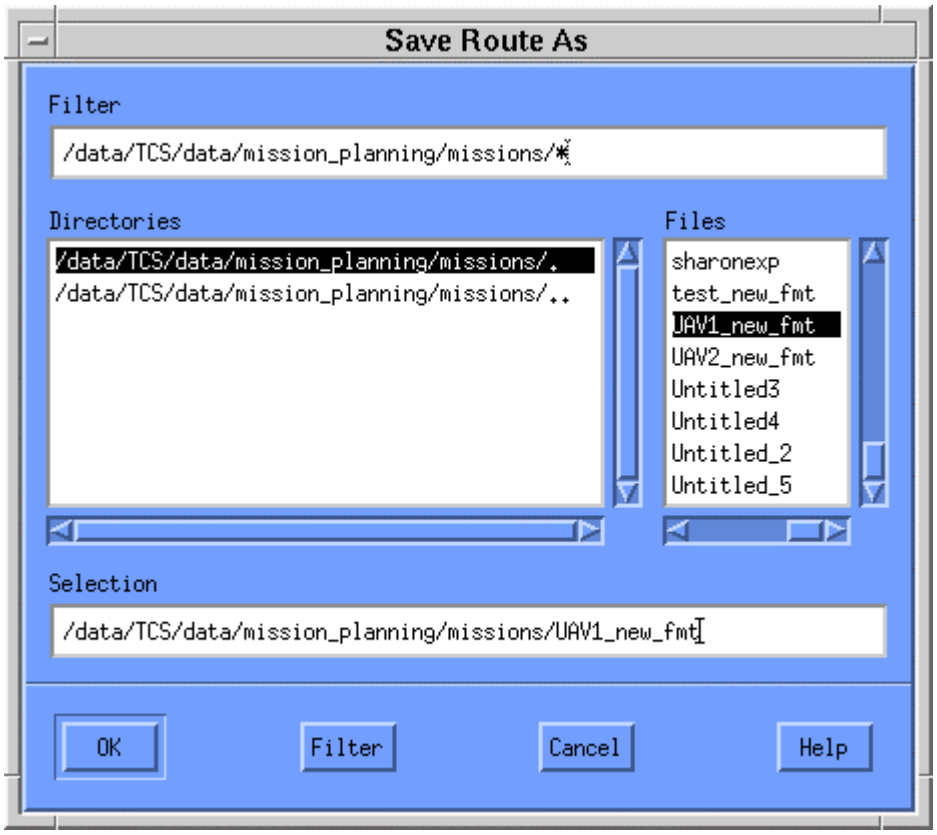

Figure 4.1.5.2-1

4.1.5.3 Results. Save Route As produces a text file consisting of the route data, including mission parameters on the disk 'mission directory'.

4.1.6 Delete Route

4.1.6.1 Purpose. The File menu, Delete Route function is used to remove route files from the disk.

4.1.6.2 Execution. To remove a route file from the disk, execute the Delete Route function from the File pull-down menu. The Delete File dialog, Figure 4.1.6.2-1, is displayed with a scrolled list of the existing routes and a route name data entry field. The user may select a route name from the list or enter a name to the data entry field. When the route file exists, it is removed from the disk when the 'OK' button is selected. A route that is loaded to the Planner and selected for deletion from the disk remains in the Planner (i.e., in memory). When the 'Cancel' button is selected, the dialog is closed without deleting the route file. Due to COE requirements the user may not change directories.

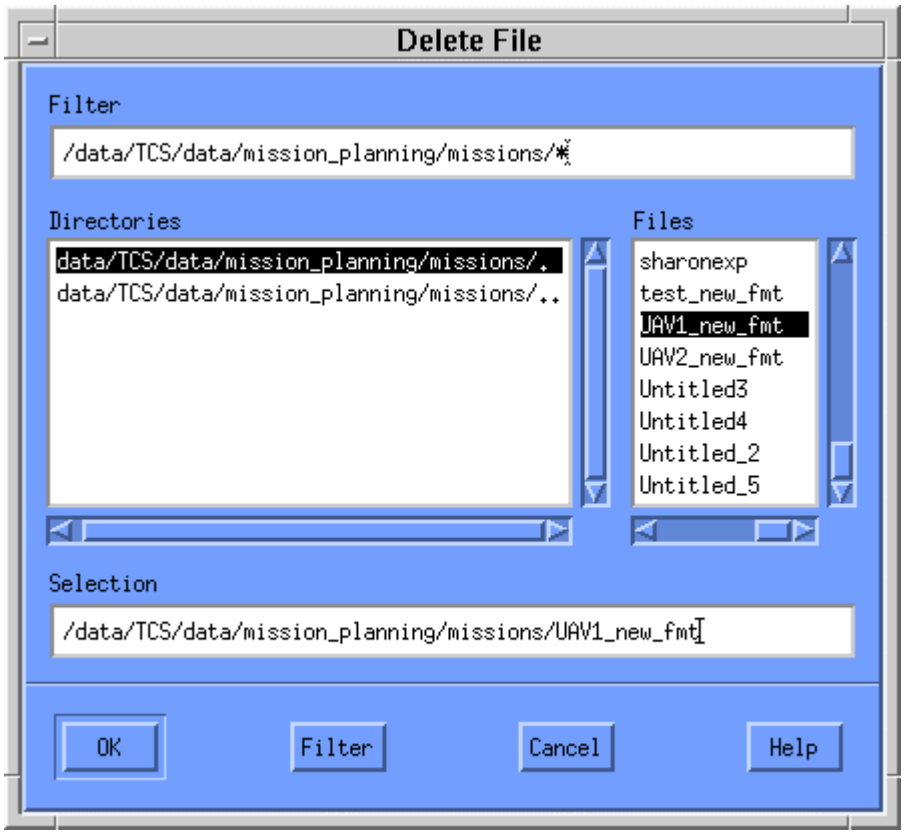

Figure 4.1.6.2-1

4.1.6.3 Results. When the Delete Route function is executed, the selected route file is removed from the disk and is no longer accessible to the Planner (unless the route is loaded into the active session or has been saved temporarily during the session).

4.1.7 Save Temp File.

4.1.7.1 Purpose. The File menu, Save Temp File function provides the user with a method of restoring an active route to a prior state. This allows the user to interactively undo a

sequence of changes to a route. The Save Temp File operation writes the active route to a temporary file. The temporary file is deleted when the Planner session is ended.

4.1.7.2 Execution. To perform an interactive save of the active route, execute the Save Temp File function from the File menu. The active route will be saved to a file in the user's home directory. The file name is based on the active route's name. A single digit is appended to the end of the route name to make each save unique. A successful save results in the display of a confirmation message in the Planner window message area.

4.1.7.3 Results. During a Planner session, up to ten versions of each route can be temporarily saved. The eleventh save of any given route will cause the last nine saves to be pushed down the list such that the first save (ending in ".0") is removed. The eleventh save is then stored with the ending of ".9". The temporary save files are deleted when the File menu, Quit function is executed.

4.1.8 Restore Temp File.

4.1.8.1 Purpose. The File menu, Restore Temp File function allows the user to restore the active route to any prior state that was saved with the Save Temp File function. The Restore function provides a dialog listing the interactive saves available for the active route. From the listing, the user can restore any saved file and continue route planning from the point of the save. If a Planner session is terminated abnormally, the interactive saves will be available for recovery when the user reenters the Planner. The user will be reminded that temporary saves exist when the route that was active at termination is loaded.

4.1.8.2 Execution. To restore a previously saved route, execute the Restore Temp File function from the File menu. The Local Restore dialog, Figure 4.1.8.2-1, is displayed with a list of session saves available for the active route. Highlight the save to be restored and select the 'OK' button. The active route is returned to the saved state. The 'Cancel' button closes the dialog without restoring any route file.

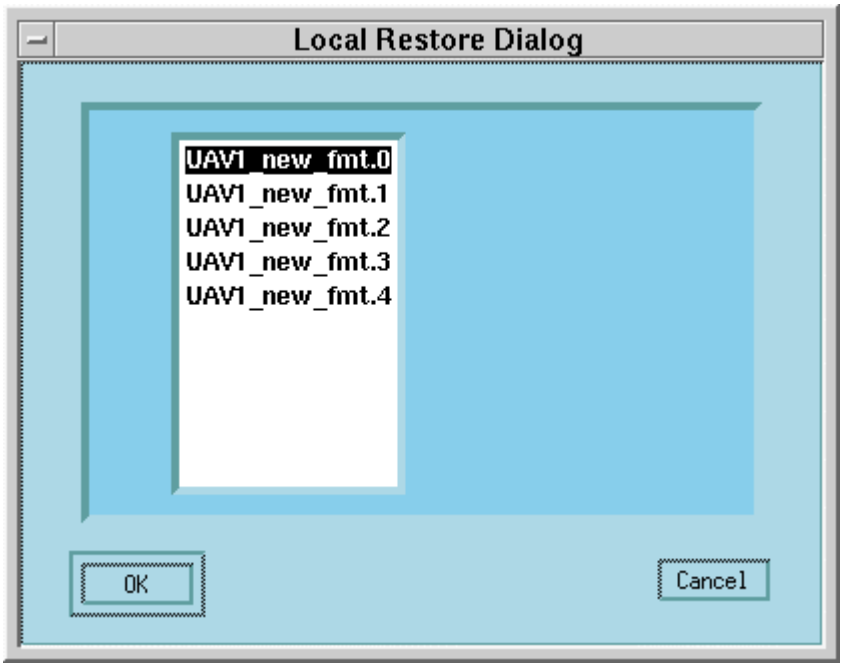

Figure 4.1.8.2-1

4.1.8.3 Results. Restore Temp File over-writes the active route in memory with the selected saved route. When the restore is complete, the drawing area is refreshed with the saved version of the route. The over-written route is lost unless it was previously saved temporarily.

4.1.9 Import Segment.

4.1.9.1 Purpose. The File Menu, Import Segment function allows the user to import a previously saved mission segment and insert it into the active mission. (The function Export Segment allows the user to save a route segment.)

4.1.9.2 Execution. To insert an external segment, position the pointer on the existing route point after which the segment to be imported will occur, and click the left mouse button. This is the reference point, which will be highlighted and its route number will be displayed. Select the Import Segment option from the File menu, or select the Import Segment hot button. The Import Segments dialog will be displayed, and the user may choose the path and name of the segment to be imported (see Figure 4.1.9.2-1). The Import Segment function may be aborted by clicking on the 'Cancel' button. After the name has been input, click the 'OK' button to import the segment.

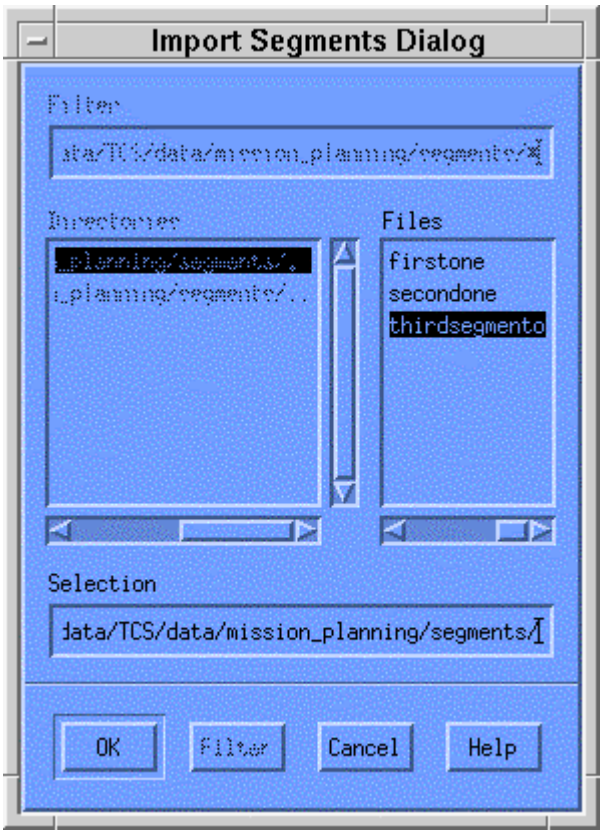

Figure 4.1.9.2-1

4.1.9.3 Results. The Import Segment results in the imported segment becoming part of the active mission. The imported segment will logically follow the reference point. The last point of the imported segment will logically tie back into the original route of flight with the point that originally followed the reference point. If the imported segment included a Launch point or a Landing point, then those points will be converted to standard route points and their altitudes will be set to the next and/or previous point's altitude of the new mission.

4.1.10 Export Segment.

4.1.10.1 Purpose. The File Menu, Export Segment function allows the user to save a segment of the active mission to disk for use in a later mission. (The function Import Segment allows the user to retrieve any segments saved with Export Segment.)

4.1.10.2 Execution. To export a segment from the active mission, select the segment to be exported. Then select Export Segment from the File menu. The Export Segment dialog will be displayed (see Figure 4.1.10.2-1). To abort the Export Segment function, select the 'Cancel' button. To complete the Export Segment dialog, enter the name for the segment and select the 'OK' button. **Caution**: no over-write message or confirmation dialog is displayed.

Figure 4.1.10.2-1

4.1.10.3 Results. The selected route segment will be saved to disk.

4.1.11 Select Route.

4.1.11.1 Purpose. The File menu, Select Route function allows the user to select the route to be active when there is more than one route loaded into the Planner. The active route is the only route available for modification, and is displayed in multiple colors reflecting the flight conditions of each segment. An inactive route is displayed as a single color.

4.1.11.2 Execution. To select an active route, execute the Select Route function on the File pull-down menu. A pull-right menu is displayed, Figure 4.1.11.2-1, listing each route loaded in the Planner. The active route is identified with an indented diamond to the left of the route name. To select the route to become active, click on the route name.

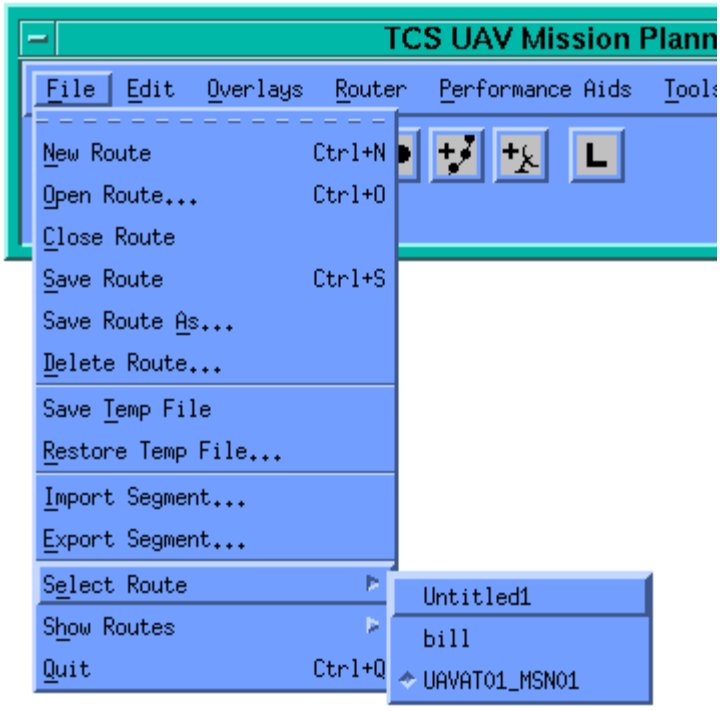

Figure 4.1.11.2-1

4.1.11.3 Results. The new active route is displayed in the defined route segment colors and the previous active route is now displayed as a solid color.

4.1.12 Show Routes.

4.1.12.1 Purpose. The File menu, Show Routes function is used to select which routes are visible in the drawing area. Initially, all routes loaded to the Planner are displayed. This function can be used to de-clutter the drawing area, while keeping the routes loaded in the Planner. This function also allows the user to redisplay any route which has been previously hidden.

4.1.12.2 Execution. To hide or show a specific route, execute the Show Routes function on the File pull-down menu. A pull-right menu is displayed, Figure 4.1.12.2-1, listing each route loaded in the Planner. The routes displayed on the drawing area are identified with a small indented square to the left of the route name. To hide a route, click on the route name. The active route cannot be hidden. To show a route which is hidden, click on the route name.

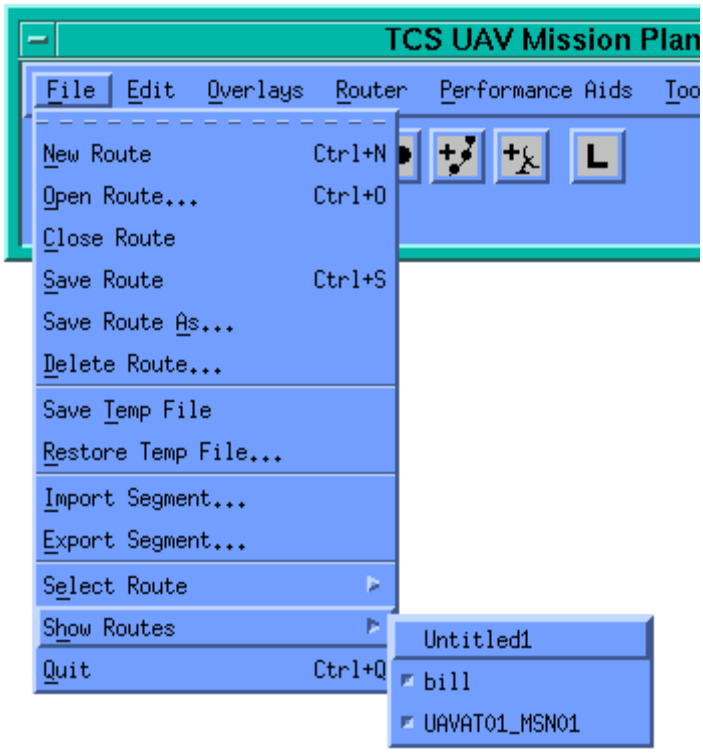

Figure 4.1.12.2-1

4.1.12.3 Results. After executing the Show Routes function, the drawing area is refreshed and only those routes designated on the Show Routes pull-right list are visible. The active route is always visible. **Note:** the Select Route function to make a route active automatically makes the route visible, negating the hide status.

4.1.13 Quit.

4.1.13.1 Purpose. The File menu, Quit function allows the user to exit the Planner.

4.1.13.2 Execution. To exit the Planner, execute the Quit function on the File pull-down menu. When there are unsaved routes, the Close Save Routes dialog, Figure 4.1.13.2-1 is displayed with a scrolled list of the routes that are loaded in the Planner. Select any modified route to be saved to disk by clicking in the small checkbox to the left of the route name. The 'OK' button saves the selected routes, closes the dialog, and closes the Planner. To cancel the Quit function and return to the Planner with no action taken, select the 'Cancel' button.

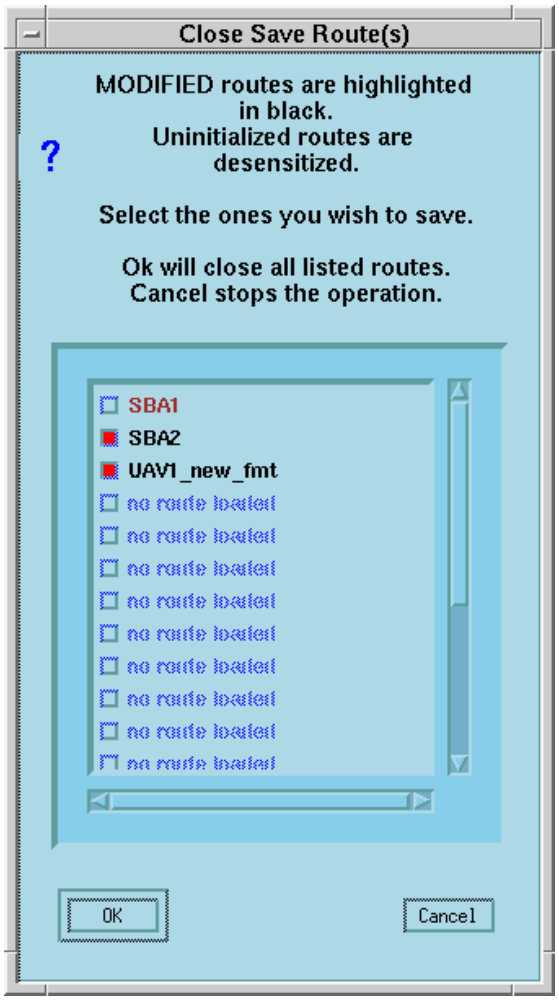

Figure 4.1.13.2-1

4.1.13.3 Results. All Planner windows are closed, the selected routes are saved to disk, and the Planner program is exited. For any route not selected for save, modifications made during the session (and not saved with the Save or Save As function) are lost.

4.2 Edit Pull-down menu

The Edit pull-down menu, Figure 4.2-1, consists of eight active options. The options allow the user to modify the active mission by adding, deleting, and modifying route points, targets and GDTs. This menu also contains an Edit Mission Parameters option, and a Set Emergency Route option.

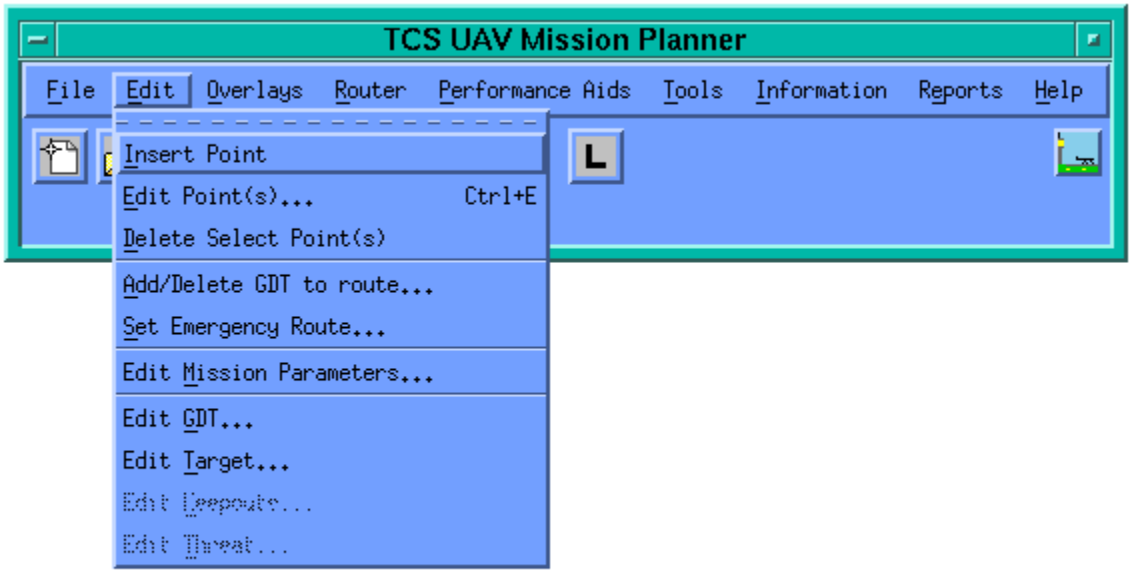

Figure 4.2-1

4.2.1 Insert Point.

4.2.1.1 Purpose. This function allows the user to insert a new route point between two points anywhere within the active route. The inserted point is logically sequenced after a reference point selected by the user from the existing route points. This function inserts the selected points in system memory, and logically connects the displayed points with a dashed line.

4.2.1.2 Execution. To insert points into the route of flight, select the existing route point after which the inserted point is to be placed, and click the left mouse button. This is the reference point, which will be highlighted, and its route point number will be displayed (see Figure 4.2.1.2-1).

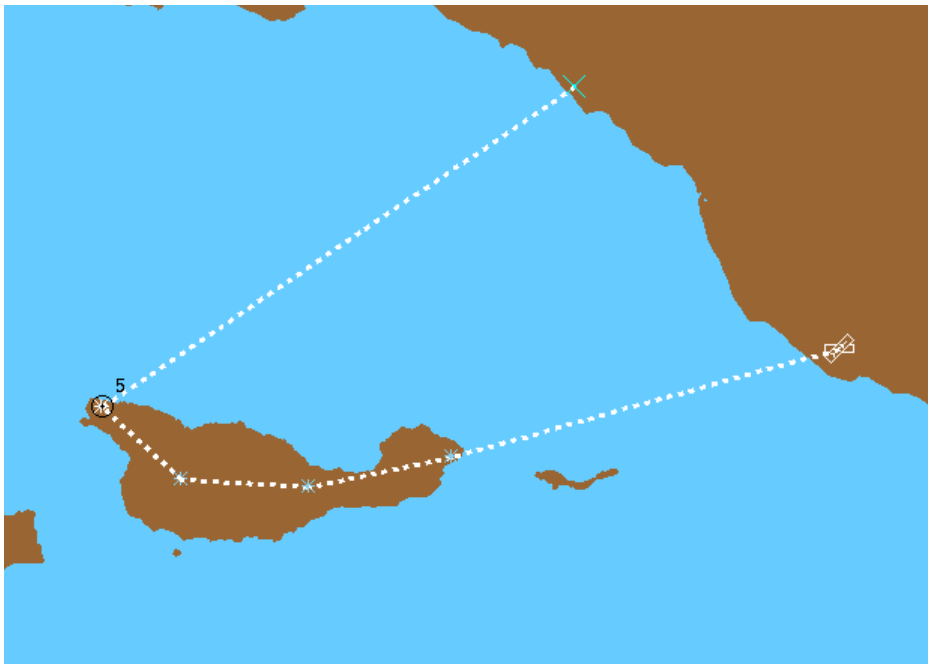

Figure 4.2.1.2-1

With the reference point designated, select the Insert Point option from the File menu, or select the Insert Point hot button. Next, press the left mouse button. The point to be inserted will be attached to the mouse pointer, along with a display of the coordinates (see Figure 4.2.1.2-2).

Figure 4.2.1.2-2

To place the route point, click any mouse button. As each point is inserted, the newly inserted point becomes the reference point and the next insertion will follow this point. The previous two steps may be repeated as desired to insert more route points. To terminate the Insert Point mode, position the mouse pointer on the (active) Main Window and press the <Escape> key. Pressing the <Escape> key while a point is attached to the mouse will cancel the insert and terminate the Insert Point mode. The route will logically flow from the first reference point in the original route of flight to the first point inserted, then to the second point inserted, followed by the third point inserted, and so on. The final point inserted will logically tie back into the original route of flight with the point that followed the original reference point (see Figure 4.2.1.2-3).

Figure 4.2.1.2-3

4.2.1.3 Results. The Insert function results in route points and unrouted segments following the reference point on the original route of flight. To complete the process, the router functions must be executed and the route finalized.

4.2.2 Edit Point(s).

4.2.2.1 Purpose. The Edit Point(s) option on the Edit pull-down menu has several functions which allow the user to change the attributes of a route point, a route segment and/or an associated image target.

4.2.2.2 Execution. The Edit dialog, Figure 4.2.2.2-1, for a given route point/segment is a tabbed dialog box. The five tabs are Waypoint, Image Point, Weather, Communication Plan, and Look Envelope. Only one of the five tabs may be displayed at any one time. The Waypoint tab will be displayed first. Each is selected by clicking on the appropriate tab. The Waypoint tab and the Image Point tab, when applicable, give the user the option of selecting a

different coordinate system (Lat/Lon, MGRS, UTM) than the global coordinate selection. Such a selection applies only to that dialog and applies only as long as that dialog remains open. To apply user modifications to the route point select the 'Apply' button. To apply user modifications and close the Edit dialog select the 'Ok' button. To close the Edit dialog without applying any changes select the 'Cancel' button. The Waypoint sub-dialog and the Image Point tab, when applicable, also give the user the option of entering a comment which is stored with the other route point information. Range of value checks are performed on each field entry. If the user-specified value is out of range, the field will be highlighted and the appropriate range of values will be displayed in the message area. After the user selects the 'Ok' or 'Apply' button, if any field contains an invalid value, the tab containing the invalid value will be displayed with the errant field(s) displayed in red.

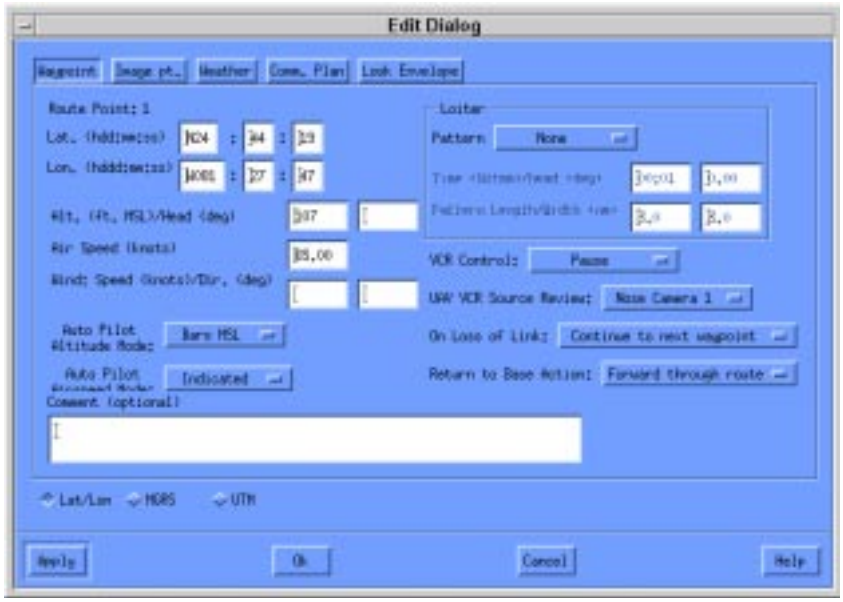

Figure 4.2.2.2-1

Edit Single Point. To modify a route point, select the route point to be edited and select Edit Point(s) from the Edit menu, or double click on the desired point with the left mouse button. The Edit dialog for the selected route point will be displayed. The description of the tabs below applies to the Predator only, however, other UAV types are similar. A tab that does not apply to the UAV type will be desensitized.

1. Waypoint. The route point number (automatically generated) is displayed. The location of the route point is displayed. The location of the route point may be modified by changing the coordinates displayed. The location of the route point can also be changed by selecting a route point on the Main Window with the left mouse button, clicking on it with the middle mouse button, moving the mouse pointer to the desired new location and clicking on the left mouse button. The altitude (ft. Mean Sea Level (MSL)) of the route point is shown and may be modified. The heading field (deg.) is optional; if no value is inserted, then the router will enter a value when the Router menu option is executed. Air Speed (knots) is displayed and may be modified. The wind speed and direction may be

entered but it is not mandatory. Auto Pilot Altitude Mode, Auto Pilot Airspeed Mode, Loiter Pattern, On Loss of Link command, Return to Base Action, Video Cassette Recorder (VCR) Control and UAV VCR Source Review options are modifiable by the user.

2. Image Point. The first time the Image pt. tab is selected the Edit Image dialog contains only the Sensor Used selection button (Figure 4.2.2.2-2). A list of sensors available on this vehicle (established from the Edit Mission Parameters dialog) is displayed when the button is selected.

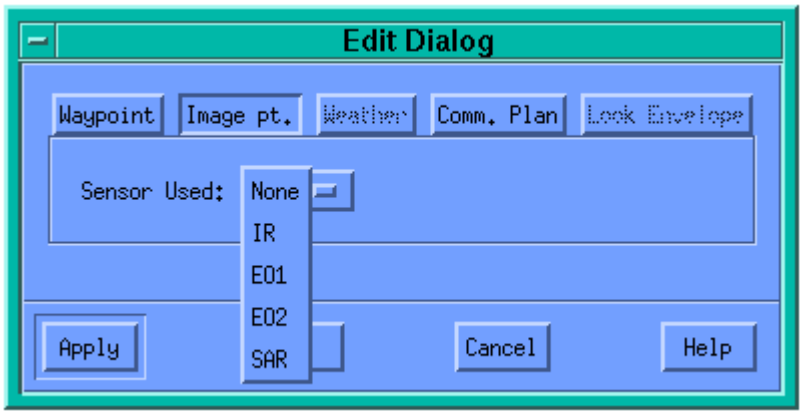

Figure 4.2.2.2-2

The user may choose a sensor to collect an image along the segment following this route point, or to collect no image by selecting None. The image edit dialog for the sensor is displayed after a sensor is selected.

The appropriate Edit Image dialog (IR, EO, SAR) is displayed whenever the Image pt. tab is selected for a point that already has a defined image.

The IR sensor dialog, Figure 4.2.2.2-3, allows the user to define an infrared sensor image at this point.

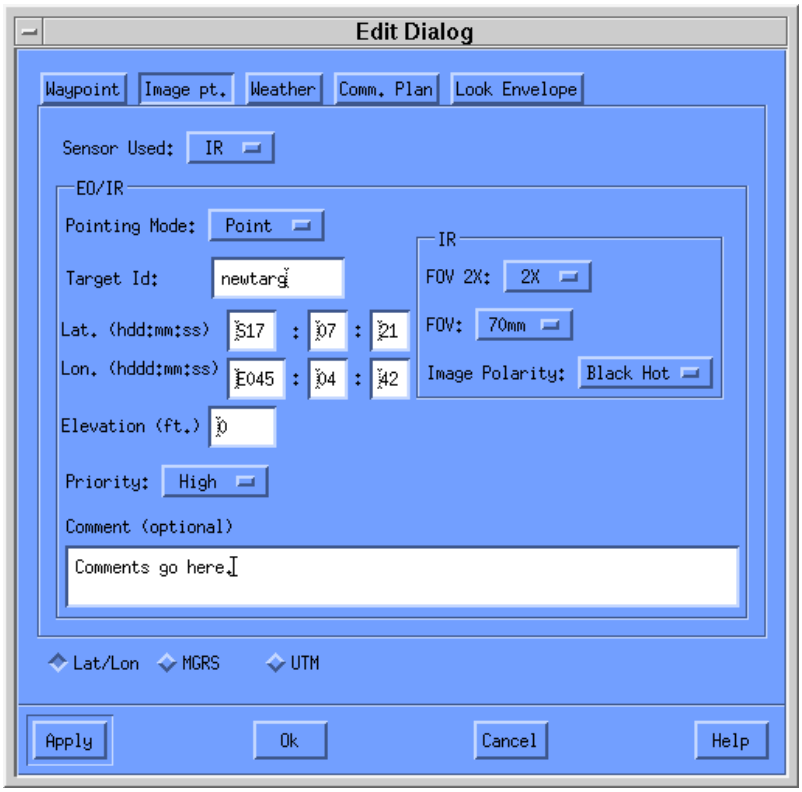

Figure 4.2.2.2-3

When a known target (see section 4.2.9) is entered in the Target Id field, the target's location and elevation will be filled in to the Image dialog. Alternately, the location of an image point for the payload may be entered alphanumerically or by clicking on a map location. If the latter is chosen, a circle depicting the position of the new choice will be displayed on the map until changes are applied, or the Edit Point(s) dialog is closed. If targets are being displayed and the map location selection results in a target being within the displayed circle, the target ID, location, and elevation will be filled in on the sensor dialog.

Additional control fields include the target priority (high, medium, low), the IR pointing mode (point or azimuth), IR FOV magnification (none or 2X), IR focal length (19mm, 70mm, 280mm), and IR Image Polarity (White hot, Black hot). Free form text may be entered to an optional Comment field. When the 'Pointing Mode' selection is set to 'Point', the target or location to be images is specified, as seen in Figure 4.2.2.2-3. When the 'Pointing Mode' is set to 'Azimuth', the user can enter an azimuth value off the nose of the AV, and a depression angle form the horizontal plane of the AV. This specifies the relative direction the sensor will point along this leg.

When the “Apply” or “Ok” button is selected, a symbol is displayed at the selected location to designate the target. Also, a dashed line is displayed that connects the symbol to the image point. **Note**: in Azimuth pointing mode no target symbol or dashed line is displayed.

The EO sensor dialog, Figure 4.2.2.2-4, allows the user to define an electro-optical sensor (EO1 or EO2) image at this point.

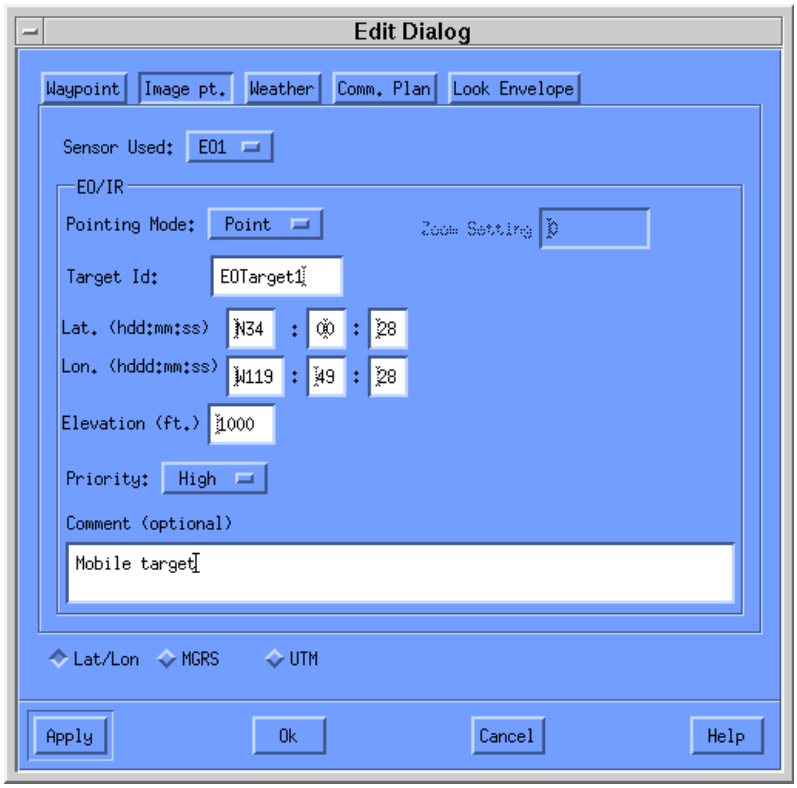

Figure 4.2.2.2-4

When a known target is entered in the Target Id field, the target’s location and elevation will be filled in to the Image sub-dialog. Alternately, the location of an image point for the payload may be entered alphanumerically or by clicking on a map location. If the latter is chosen, a circle depicting the position of the new choice will be displayed on the map until changes are applied or the Edit Point(s) dialog is closed. If targets are being displayed and the map location selection results in a target being within the displayed circle, the target ID, location, and elevation will be filled in on the sensor dialog

Additional control fields include the target priority (high, medium, low) and the EO pointing mode (point or azimuth). Free form text may be entered to an optional Comment field. When the “Pointing Mode” selection is set to “Point", the target or location to be images is specified, as seen in Figure 4.2.2.2-4. When the “Pointing Mode” is set to “Azimuth", the user can enter an azimuth value off the nose of the AV, and a depression angle form the horizontal plane of the AV. This specifies the relative direction the sensor will point along this leg.

When the “Apply” or “Ok” button is selected, a symbol is displayed at the selected location to designate the target. Also, a dashed line is displayed that connects the symbol to the image point. **Note**: in Azimuth pointing mode no target symbol or dashed line is displayed.

The SAR sensor dialog, Figure 4.2.2.2-5, allows the user to define a Synthetic Aperture Radar (SAR) image at this point.

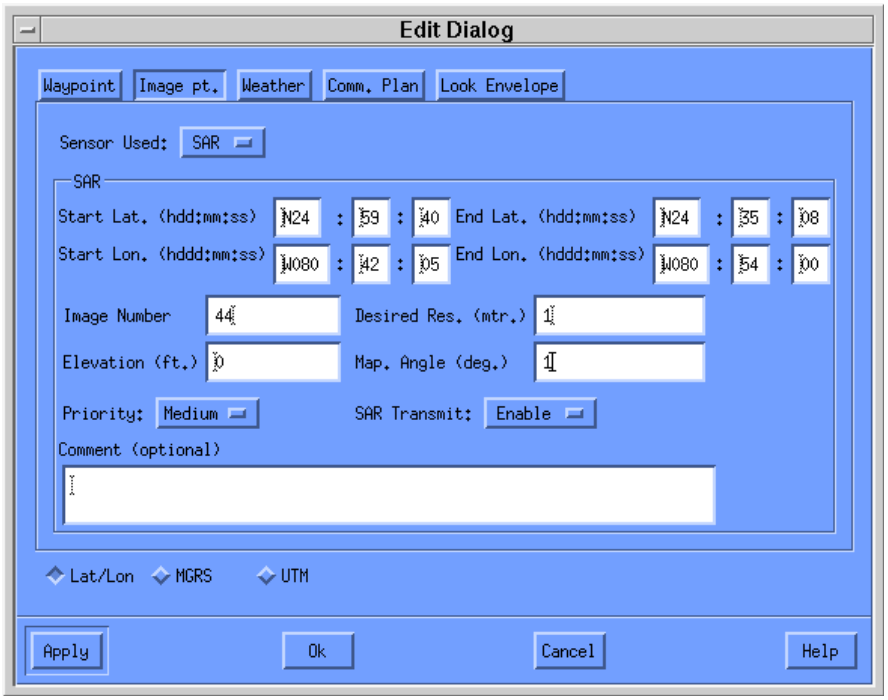

Figure 4.2.2.2-5

Locations of SAR image strips may be entered alphanumerically by entering the beginning and ending coordinates of the strip (Start Lat/Start Lon, End Lat/End Lon as seen in figure 4.2.2.2-5). Alternately, the strip may be generated graphically by dragging a line across the map window. The Image Number field (0 - 65535), Desired Res(olution) (0 - 999 meters), Map Angle (-90 to 90 degrees), and target area Elevation fields must be competed. The Elevation field is automatically filled when DTED data is available. Additional control fields include the target priority (high, medium, low) and SAR Transmit (Enable, Disable). Free form text may be entered to an optional Comment field.

A parallelogram originating at the point and including the SAR image strip on the opposite side is displayed (see Figure 4.2.2.2-6) when the “Apply” or “Ok” button is selected.

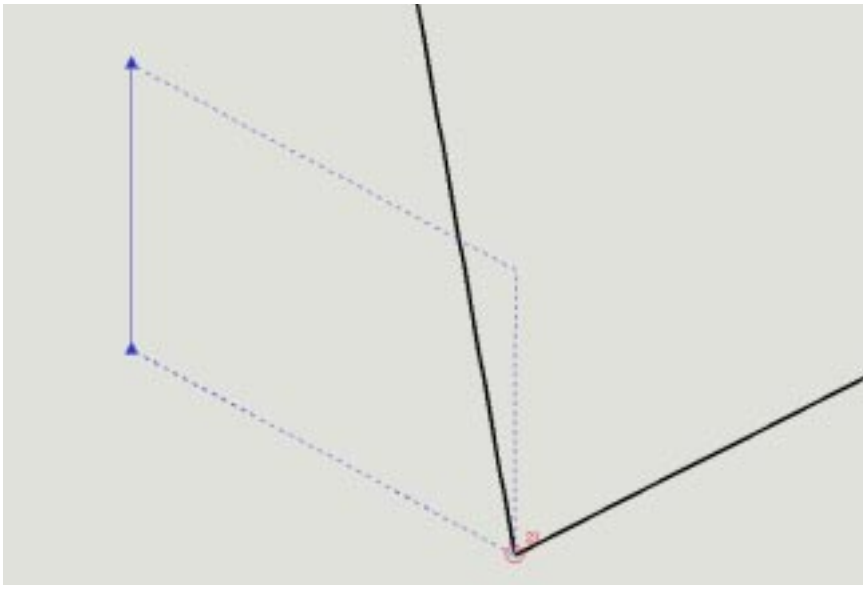

Figure 4.2.2.2-6

3. Weather. The Edit dialog Weather tab is sensitized for each route point with an associated image point. Clicking on the Weather tab will display the weather dialog seen in Figure 4.2.2.2-7.

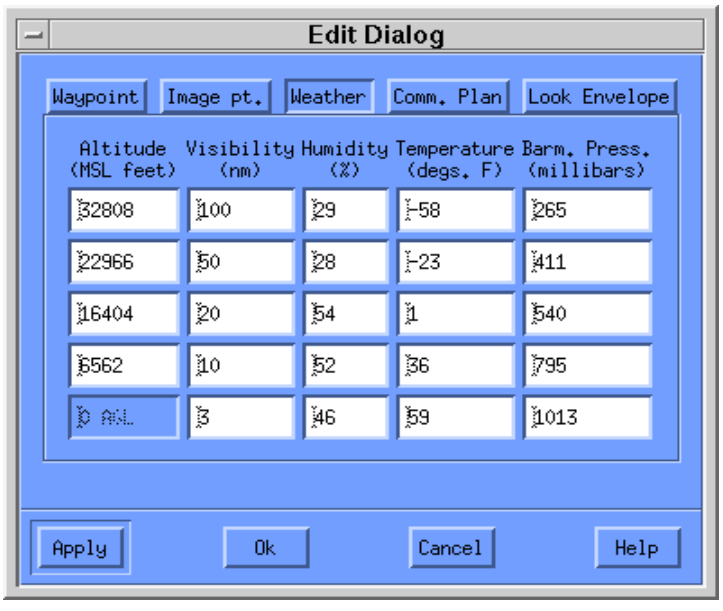

Figure 4.2.2.2-7

The user may modify the Visibility (Nautical Miles), Humidity (percent), Temperature (degrees Fahrenheit) and Barometric Pressure (millibars) for five (user modifiable) altitude bands. Figure 4.2.2.2-7 shows the Weather dialog with default values. Changes to the weather data will affect the sensor's ability to see the target. The weather data applies to the target location, not the route point.

4. Communications Plan. Each route point has a communications plan dialog (see Figure 4.2.2.2-8). User modifiable fields are Datalink (none, LOS, Ku-band), Communication Satellite Longitude (hddd:mm:ss), Satcom Channel Number (0-100), Communication Frequency (240-16000 kHz) and Identification Friend or Foe (IFF) settings (on/off) and Squawk Code (0-7777 octal).

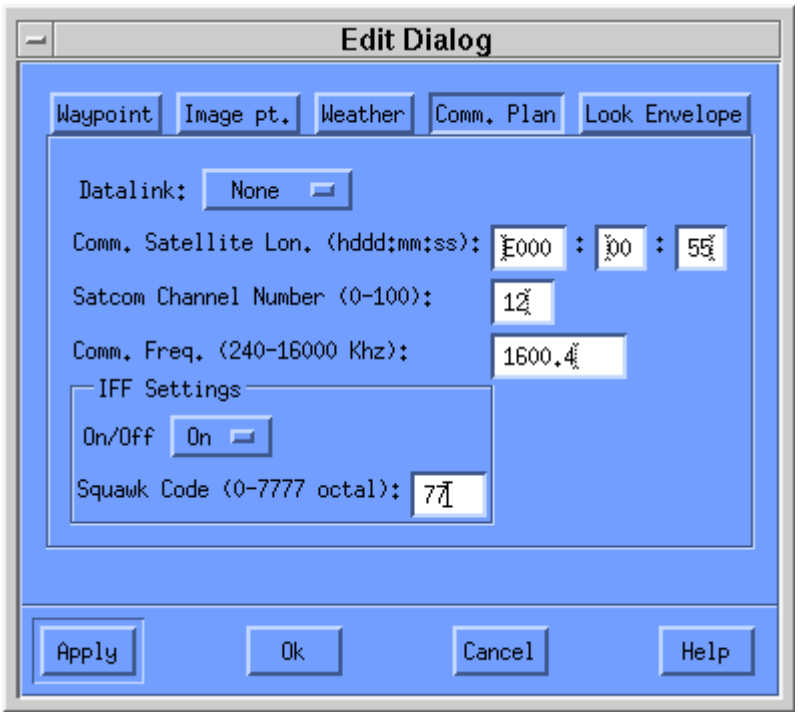

Figure 4.2.2.2-8

5. Look Envelope. For each point with an associated image target, the user may elect to display a look envelope (Figure 4.2.2.2-9) for that image target.

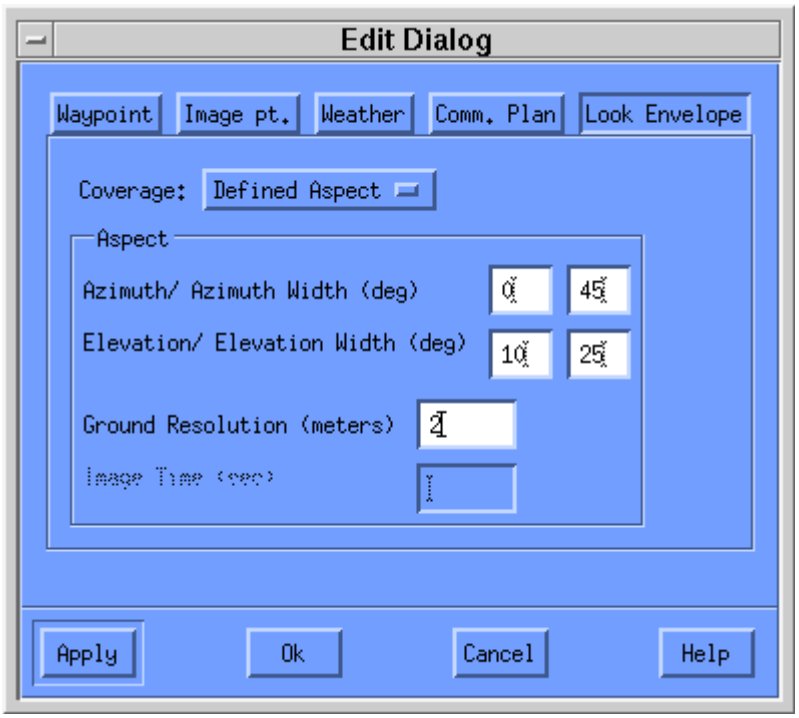

Figure 4.2.2.2-9

The look envelope, a shaded area about the image target, will enable the user to further determine where the target can be seen (see Figure 4.2.2.2-10). In order for a sensor to image a target, the target must be within both the sensor's angular limits (azimuth and elevation), and between the minimum and maximum sensor range limits. This defines a three dimensional volume within which the target must lie to be imaged.

The “Coverage” button allows turning the envelope off, specifying Full Range, or Defined Aspect. Full range will produce two shaded envelopes representing the minimum and maximum sensor range (outer envelope), and the minimum and maximum depression angle limits. The intersection of these regions represents the region the route must pass through to obtain a target image. When Defined Aspect coverage is selected, the user may enter Azimuth (clockwise from true north) and Elevation (up from horizontal) values. If the Azimuth Width is zero for a SAR image, a trapezoid envelope is displayed and the route must traverse a straight line through the two sides of the trapezoid.

The “Ground Resolution” field allows the user to specify the smallest dimension to be resolved. For SAR, operating minimum and maximum ranges are always used. When the Ground Resolution value is zero, a contrast range is estimated for EO and IR sensors.

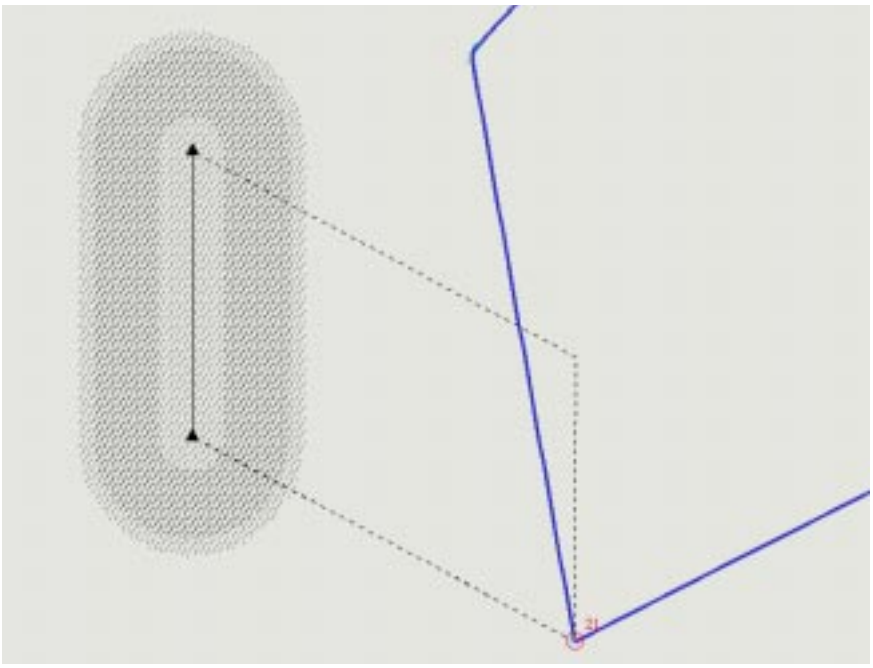

Figure 4.2.2.2-10

Edit Segment. To modify a route segment, select the begin and end points of the segment to be modified (see page 4) and select Edit Point(s) from the Edit menu. The Edit dialog for the selected segment will be displayed. The route number of the first point of the segment will be displayed as the route number. The number of fields that can be modified in the Edit dialog are limited when choosing to edit a segment. The modifiable fields for Edit a Segment are Altitude, Air Speed, Wind Direction, Wind Speed and all Communications fields. Applying a change to a segment changes all these fields for all route points in the segment.

4.2.3 Delete Select Point(s).

4.2.3.1 Purpose. The Delete Select Point(s) function, Figure 4.2.3.1-1, allows the user to remove points from the active route. When a point is deleted, the segment into the designated point, as well as the segment out of the designated point are also deleted, and a logical connection is formed from the point prior to the deleted point to the point after the deleted point. When a segment is deleted, the segment into the begin point, the segment between the two designated points, and the segment out of the end point will be deleted.

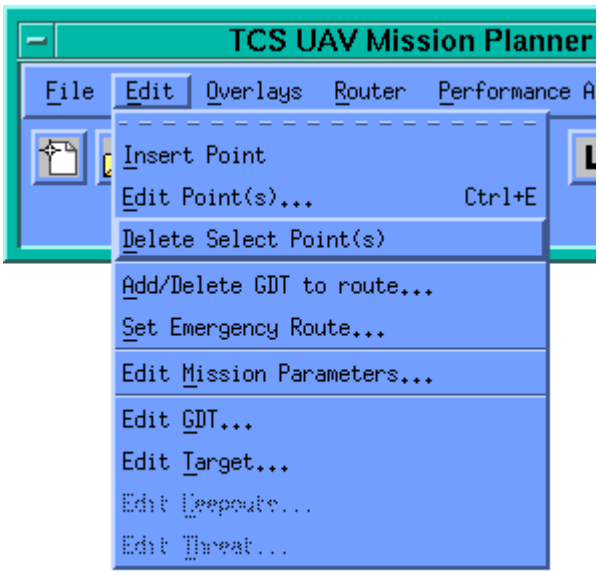

Figure 4.2.3.1-1

4.2.3.2 Execution. To delete a route point, select the point to be deleted by clicking on the point with the left mouse button. The designated point will be highlighted and its route point number will be displayed. Selecting the Delete Select Point(s) option from the Edit Menu, or pressing the <Delete> key, results in the display of a Delete dialog warning the user that continuation will result in the deletion of the selected point and adjacent route segments (see Figure 4.2.3.2-1). Select the Delete dialog's "OK" button to continue with the deletion, or the "Cancel" button to terminate the delete function without changing the route.

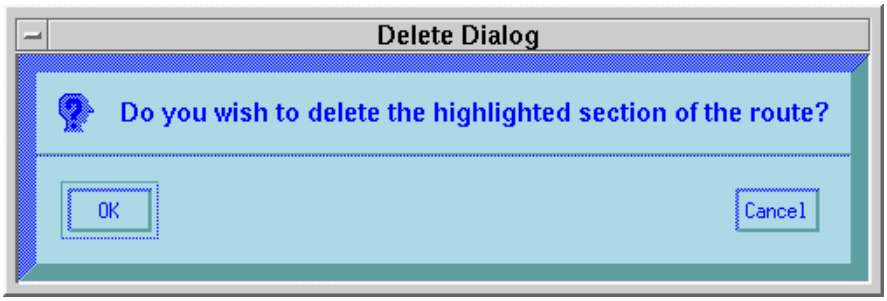

Figure 4.2.3.2-1

To delete a route segment, select the segment to be deleted. The designated segment will be highlighted and its first and last route point numbers will be displayed. Selecting the Delete Select Point(s) option from the Edit Menu or pressing the <Delete> key results in the display of a Delete dialog warning the user that continuation will result in the deletion of the selected segments and adjacent route segments. Select the Delete dialog's "OK" button to continue with the deletion or the "Cancel" button to terminate the delete function without changing the route.

4.2.3.3 Results. Deletion of a point or segment results in the removal of selected points and segments from the route that is stored in memory. With the exception of the Launch Point and the Landing Point, any route point or segment can be deleted.

4.2.4 Add/Delete GDT to Route

4.2.4.1 Purpose. This function allows the user to add or delete ground data terminals to the list of GDTs that are associated with the active route.

4.2.4.2 Execution. To add and/or delete GDTs to the active route, select Add/Delete GDT to Route from the Edit menu. The Attach GDTs dialog, Figure 4.2.4.2-1, will be displayed with a list of available GDTs and a list of GDTs attached to the active route. To add a GDT to the route, select the desired GDT in the Available GDTs list and click on the arrow pointing to the Attached GDTs list. The GDT will then appear in the Attached GDTs list. To remove a GDT from the route, select the GDT in the Attached GDTs and click on the arrow pointing to the Available GDTs. The GDT will be removed from the Attached GDTs list. To abort, select the "Cancel" button. Click on the "Ok" button to exit and close the dialog. **Note**: if GDTs are being displayed, clicking on a GDT in the drawing area will highlight it's ID in the Available GDTs list.

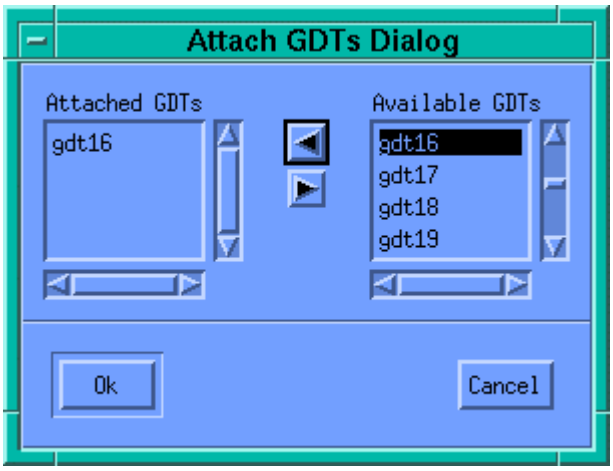

Figure 4.2.4.2-1

4.2.4.3 Results. The selected GDT will be added to the list of available GDTs for the route. GDTs associated with the route will now be considered during communications planning. Additionally, the router will attempt to keep the route within the GDT coverage.

4.2.5 Set Emergency Route

4.2.5.1 Purpose. This function allows the user to associate an emergency route to a mission.

4.2.5.2 Execution. By default, a route has no emergency route associated with it. To set an emergency route, the user must have at least one emergency route loaded and an active route other than the emergency route. From the Edit menu select Set Emergency Route. A list of the loaded emergency routes will be displayed (Figure 4.2.5.2-1). To abort the Set Emergency

Route function, select the “Cancel” button, otherwise select the emergency route to associate with the active route and select the “Ok” button. The user may remove an emergency route associated to the active route by clearing all highlights and selecting “Ok”. The user may change this association at any time by repeating this procedure.

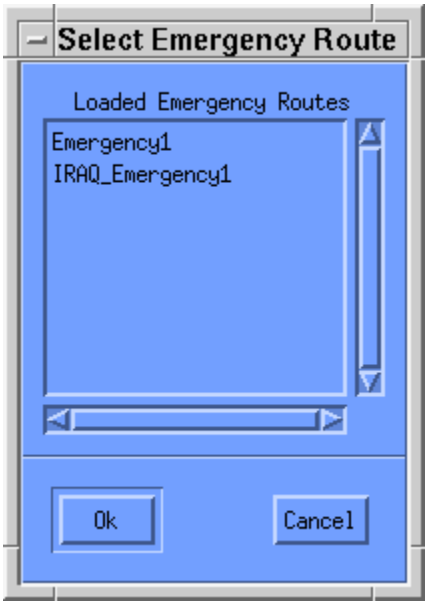

Figure 4.2.5.2-1

4.2.5.3 Results. The selected emergency route is the emergency route associated to the active route. **Note**: an emergency route may be associated to more than one route.

4.2.6 Edit Mission Parameters.

4.2.6.1 Purpose. The Edit menu, Edit Mission Parameters function allows for the alteration of general parameters pertaining to the mission as a whole.

4.2.6.2. Execution. To alter general mission parameters, execute the Edit Mission Parameters function from the Edit pull-down menu. The Edit Mission Parameters dialog, Figure 4.2.6.2-1 is displayed. Alter numeric text fields, radio button fields, toggle and check boxes and select the “Ok” button to apply the changes. The “Cancel” button exits the dialog without applying the changes.

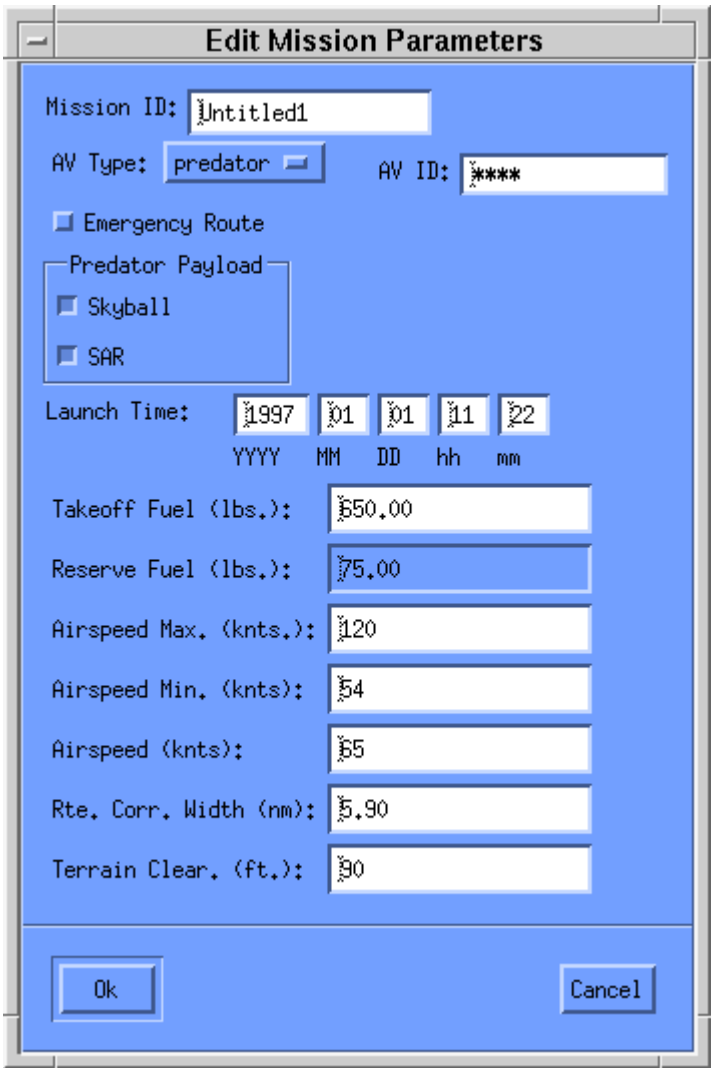

Figure 4.2.6.2-1

The Mission ID text field identifies the name of the route that will be saved to disk. The name cannot be a duplicate to an existing route. This is a mandatory field.

AV Type button allows selection of type of air vehicle to be used with this mission. A list of AV Types, created by the Edit Air Vehicle function, is displayed when this button is clicked. Most of the remaining fields of this dialog will display default values which the user has defined for the AV Type.

The AV ID text field specifies a particular vehicle (tail number) of the AV type.

The Emergency Route checkbox is used to identify the route as a special case of route type emergency. An emergency route can be associated to another route.

The Payload checkbox area allows selection of a payload combination for this mission.

The Launch Time consists of five fields to identify the year (YYYY), month (MM), day (DD), hour (hh - 24 hour clock), and minute (mm) the vehicle will be launched.

Takeoff Fuel (lbs.) text field specifies the weight of the fuel in pounds at takeoff. This is a mandatory field.

Reserve Fuel (lbs.) text field specifies the weight of the reserve fuel that is desired at the landing. This is a mandatory field.

Airspeed Max. (knts.) text field specifies the maximum airspeed in knots for the vehicle on this mission. This is a mandatory field.

Airspeed Min. (knts.) text field specifies the minimum airspeed in knots for the vehicle on this mission. This is a mandatory field.

Airspeed (knts.) text field specifies the default airspeed in knots for the vehicle on this mission. This is a mandatory field.

Rte. Corr. Width (nm) text field specifies the width in nautical miles perpendicular to the flight path to be considered for terrain clearance and communication link checks. This mandatory field represents the uncertainty of the AV location along the flight path.

Terrain Clear. (ft.) text field specifies the minimum altitude in feet above terrain to fly the vehicle. This mandatory field will prevent the user from specifying a point that will be below this terrain clearance.

4.2.6.3 Results. The mission and air vehicle are identified and constraints are specified for route points.

4.2.7 Edit GDT

4.2.7.1 Purpose. This function allows the user to modify, add and/or delete ground data terminals from the GDT database.

4.2.7.2 Execution. To modify, add or delete a GDT from the GDT database, select Edit GDT from the Edit menu. The Edit GDT dialog will be displayed (see Figure 4.2.7.2-1). The modifiable fields in the Edit GDT dialog are GDT ID, Coordinates (Lat/Lon, Military Grid Reference System (MGRS), Universal Transverse Mercator (UTM) selectable from Main Toolbar), Elevation, Antennae Height, Capabilities and Comment. To modify a GDT select its GDT ID from the list. The information for this GDT is displayed and is modifiable. Coordinates may be entered alphanumerically or by clicking on the desired map location. When the latter is chosen, a circle depicting the position of the new choice will be displayed on the map until changes are applied or the Edit GDT dialog is closed. To apply changes select the “Apply” button or to exit without applying changes select the “Close” button. To add a GDT to the list, enter a new GDT ID, complete the remaining fields, and select “Add”. To Delete a GDT from the list, select the GDT ID from the list and click “Delete”. Select “Close” at any time to exit from the Edit GDT dialog.

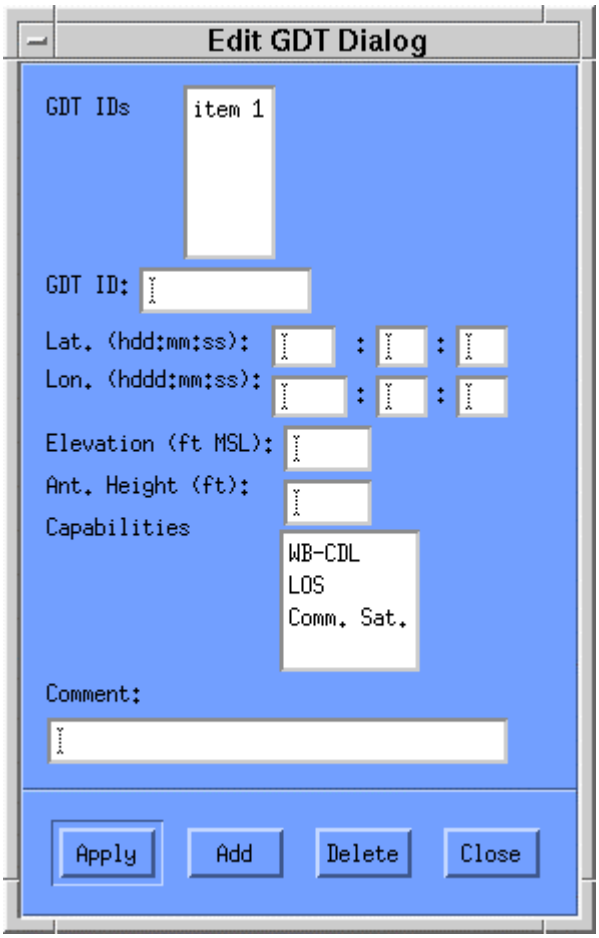

Figure 4.2.8.2-1

4.2.7.3 Results. The specified GDTs will be modified, added and/or deleted from the GDT database.

4.2.8 Edit Target

4.2.8.1 Purpose. This function allows the user to modify, add and/or delete targets from the target database.

4.2.8.2 Execution. To modify, add or delete a target from the target database select Edit Target from the Edit menu. The Edit Target dialog will be displayed (see Figure 4.2.8.2-1). The modifiable fields in the Edit Target dialog are Target ID, Coordinates (Lat/Lon, MGRS, UTM selectable from Main Toolbar), Elevation, Country Code and Comment. To modify a target select its Target ID from the list. The information for this target is displayed and is modifiable. Coordinates may be entered alphanumerically or by clicking on the desired map location. If the latter is chosen, a circle depicting the position of the new choice will be displayed on the map until changes are applied or the Edit Target dialog is closed. To apply changes select “Apply”, or to exit without applying changes select “Close”. To add a target to the list, enter a new target ID, complete the remaining fields, and select “Add”. To Delete a target from the list, select the Target ID from the list and click “Delete”. Select “Close” at any time to exit from the Edit Target dialog.

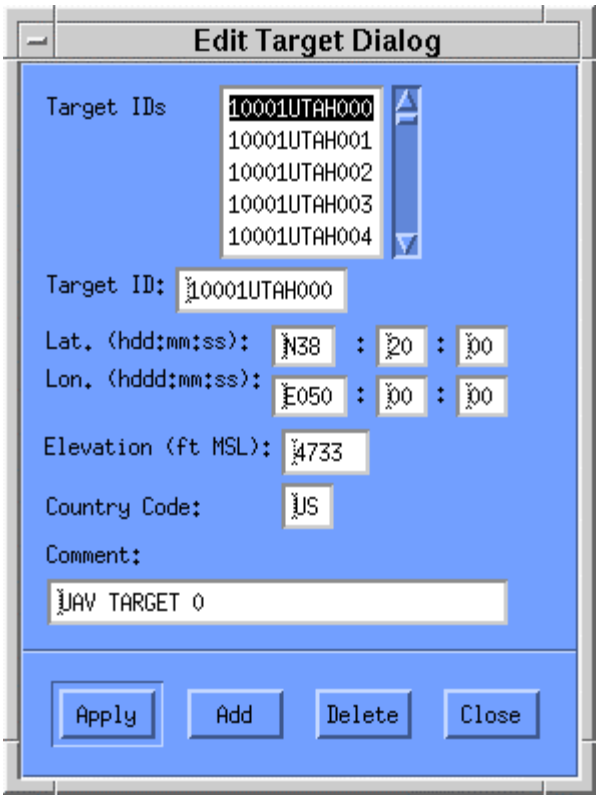

Figure 4.2.8.2-1

4.2.8.3 Results. The specified targets will be modified, added and/or deleted from the target database.

4.3 Overlays Pull-down Menu.

The Overlays menu, Figure 4.3-1, provides the user the capability to display various graphical symbols over the drawing area.

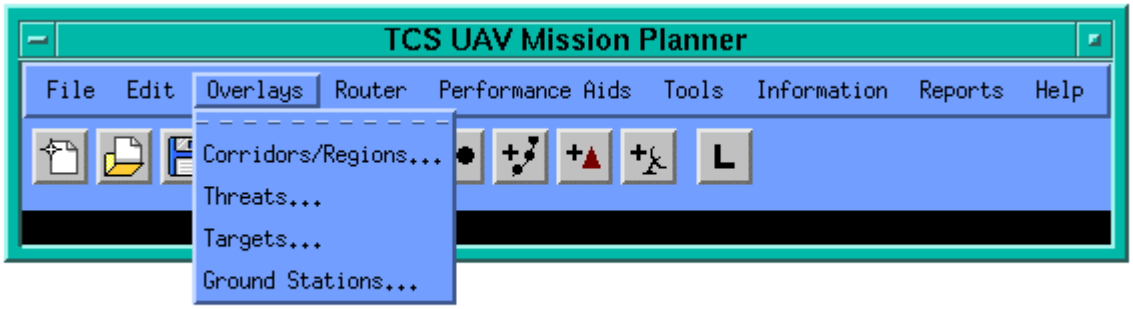

Figure 4.3-1

4.3.1 Corridors/Regions.

4.3.1.1 Purpose. Displaying regions avoided by the router can enhance the user's ability to analyze the routed mission. The Keepout zones and Airborne Warning and Control System (AWACS) polygons may be individually selected from the Display Corridors dialog, Figure 4.3.1.1-1. Each corridor/region option is preceded by an on/off button and followed by a color selector. The option is on when the button is depressed. The color selector allows the user to change the color of the corridor or region type. The "Ok" button refreshes the background display with the selected corridors and regions in the appropriate colors. The "Cancel" button exits the function without altering the original background.

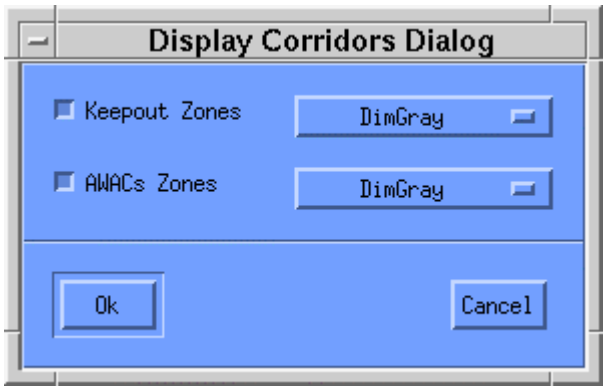

Figure 4.3.1.1-1

4.3.1.2 Execution. A Keepout Zone is a polygon consisting of up to 500 points. The three dimensional zone is assigned a minimum and maximum altitude and a penalty weight. The weights are used in the router 3D Avoidance to avoid penetrating the polygon. **Note**: the two dimensional display of the route may appear to pass through a keepout zone when, in fact, it is passing under or over the region.

AWACS polygons are composed of five orbit points, with each orbit point used as the center of a circle with a fixed radius. The circle is converted to an eight-sided polygon and assigned a penalty weight. The weights are used in 3D Avoidance to avoid penetrating the polygon.

4.3.1.3 Results. The Keepout and AWACs zones are displayed on the drawing area in the chosen colors.

4.3.2 Threats. The Threat overlay function allows the user to control the display of threats on the drawing area. After the Low Observable (LO) router function is executed, all threat exposures that exceed the duration specified on the exposure time display threshold are displayed as dashed lines (strobes). The strobes originate from the threat and extend to the point on the route where exposure occurs. The strobes are displayed even though the threats may not yet be selected for display. However, once threats are displayed, only exposures from the displayed threats appear. Exposure duration is confined to individual route segments. This means that a segment with a duration less than the exposure display threshold duration will never display exposure even though exposures may occur.

4.3.2.1 Purpose. The Threat overlay function is used to adjust the threat display background on the drawing area. The function displays weapon systems (Surface to Air Missile (SAM), Anti-Aircraft Artillery (AAA), and fighters) and radar types. For each threat

type, aircraft vulnerability varies with altitude. Therefore, in addition to the threat types which can be displayed, the Threat display function contains a list of aircraft altitude bands. The Threat Display function is used to select the threat types to be displayed for a single aircraft altitude band. The altitude is used to determine which threat types are effective and the size of the avoidance ring to display around the effective sites. Whenever the user is considering an altitude that differs from the active threat altitude, the Threat display function should be called and the altitude adjusted.

4.3.2.2 Execution. Selection of the Threat option on the Overlays pull-down menu will cause the Threat dialog, Figure 4.3.2.2-1, to appear. This dialog is used to select a subset of threats for display and define the threat attributes associated with each displayed threat.

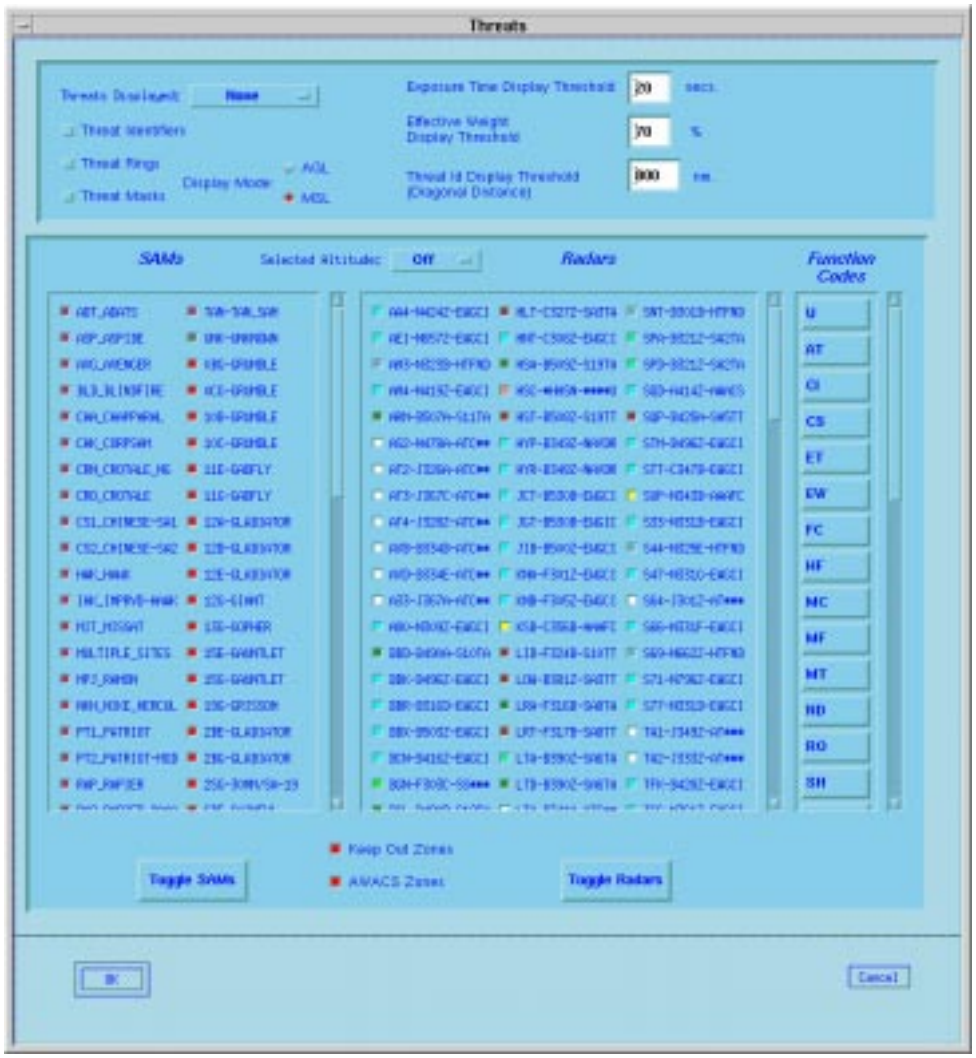

Figure 4.3.2.2-1

The Threats Displayed button has two alternatives: None and All. ‘None’ is the default selection, removing all threats from the display. ‘All’ will display world-wide occurrences of the selected threat types. The chosen option will be printed on the Threats Displayed button.

A threat identifier (ID) is a three character mnemonic used to uniquely identify a specific threat type. This on/off option allows the user to display the threat site ID. When the button is depressed, the mnemonic will be displayed when the width distance of the zoom is less than the Threat ID Display Threshold.

A threat ring is the penalty area used by 3D Avoidance in determining the minimum penalty path. This on/off option allows the user to display the appropriate threat ring around each site displayed. When the on/off button is depressed, threat rings will be displayed. This attribute is aircraft altitude dependent and will vary as different altitudes are selected.

A Threat Mask function accounts for the effect of terrain masking by shading the portion of the threat ring in which the aircraft is visible to the radar site. This on/off option allows the user to display the appropriate threat mask around each site displayed. The color of the shading corresponds to the color associated with the parent threat type. This attribute is aircraft altitude dependent and will vary as different altitudes are selected. To improve GUI performance with this option on, threat masks are displayed only when the width distance of the zoom is less than the Threat ID Display Threshold.

The Display Mode consists of two buttons allowing the user to choose either Above Ground Level (AGL) or Mean Sea Level (MSL) threat masks. When AGL is selected, the terrain mask displayed will be based on a computed MSL using the threat site's elevation plus the selected altitude. When the Display Mode is MSL, the selected altitude is used directly. Currently only the MSL mode is supported. **Warning**: If the Display Mode is MSL and the altitude selected is below the terrain elevation for a specific site, the site will appear to have no mask. In effect, the aircraft is below ground level and the site is totally masked. Therefore, for low altitudes it is recommended that the AGL option be used. **Note**: currently only the MSL option is available.

The Exposure Time Display Threshold controls the display of exposure strobes by limiting them to exposure of duration greater than or equal to the threshold. This text entry field reflects a duration time in seconds and can be set up to 999 seconds or, for the display of every exposure, set to 0 seconds. The default setting is 20 seconds which is based on a second look by a site with the typical scan rate of 10 seconds. If a segment's duration is less than the exposure time threshold, exposures for that segment will not be displayed. The exposure time display threshold affects only the exposures displayed and does not affect the router's determination of exposure. Initially, all of the exposures that exceed the default display threshold duration are displayed and none of the threats are displayed. However, once threats are displayed, exposures will only be displayed for the threat type subset that is selected for display.

The Effective Weight Display Threshold controls the symbology used to display individual radar and weapon sites. A radar site with an effectiveness remaining less than the percentage specified in this text field will appear as a solid square rather than as a radar antennae. A weapon site with an effectiveness remaining less than the percentage specified will appear as a solid circle rather than a missile symbol. To change the threshold percentage, the user types over the active value with the desired level of effectiveness remaining.

The Threat ID Display Threshold controls the display of threat identifiers when the Threat Identification attribute is active. The text window reflects a zoom width distance in NM. With the Threat Identification attribute on, any time the user zooms such that the width distance of the display is less than the threshold, the threat identifiers will appear adjacent to their associated sites. The threat identifier is a three character mnemonic, unique for each threat type. To change the threshold distance, the user types over the active value with the desired zoom distance.

Aircraft altitude is a variable in determining threat radii for effective threats. As different altitudes are selected, various threat types on the Threats dialog will become desensitized, indicating they are not effective against the Air Vehicle at that altitude. Ineffective threat types cannot be selected for display. For the subset of effective threats selected for display, the altitude determines the threat radii used to calculate the 3D avoidance circle displayed. The altitudes displayed for the selection process represent the nominal altitudes used to represent a band of altitude. For example, a nominal altitude of 12,000 feet may be composed of a band from 10,000 feet to 13,000 feet. The nominal altitude will be used to generate the footprint contours, and for segments flown within the band, the 12,000 foot contour will be displayed. In addition, a single radii, based on the threat's capability at 12,000 feet, will be used to represent the effectiveness of a threat type whenever the aircraft is within the 10,000 to 13,000 foot altitude band. Only one altitude can be selected. If threat type selection occurs after altitude selection, an effectiveness test will occur to determine if the selected threat is effective at the selected altitude. The altitude selection will be echoed on the button itself. This altitude band will also be used to determine the terrain masks that are displayed for threats, targets and GDTs.

On the Threat dialog, threat types are divided into SAMs and radars. The two divisions contain separate scrollable lists of the individual threat type names preceded by an on/off button.

The SAM division represents all weapon systems (i.e., Surface-to-Air Missiles (SAM), Anti-Aircraft Artillery (AAA), and fighter bases.) Each threat type is preceded by an on/off button. When the button is colored, the associated threat type has been selected for display. Selection of multiple threat types is possible. Each weapon system selected for display will be evaluated for effectiveness at the designated altitude. If a weapon system is found to be ineffective at the designated altitude, the threat type will automatically be toggled off. By selecting the button preceding an effective threat type, the user can alter its display status. However, if the threat type is ineffective at the designated altitude, the off status cannot be changed. The SAM division is a scrollable list of up to 100 unique weapon systems.

The radar division represents all electronic emitters. Each threat type is preceded by an on/off button. When the button is colored, the associated threat type has been selected for display. Selection of multiple threat types is possible. Each radar selected for display will be evaluated for effectiveness at the designated altitude. If a radar is found to be ineffective at the designated altitude, the threat type will automatically be toggled off. By selecting the button preceding an effective threat type, the user can alter its display status. However, if the threat type is ineffective at the designated altitude, the off status can not be changed. The Radar division is a scrollable list of up to 250 unique radar types.

Threat types can be grouped according to function (i.e., early warning (EW), target acquisition (TA), Gecko SAMs (SA8)). The functions found for the threat types in the active database are displayed as a scrollable list on the Threat dialog. The user may select a functional subset of threat types for display by toggling off all radars and/or weapon systems and then choosing, by function, those threats desired for display. The system will remember the subset selection as different altitude bands are selected.

If weapon systems have previously been selected for display, the toggle function will turn them off. If all weapon systems are actively off, the toggle function will turn on the weapon systems effective at the selected aircraft altitude.

If radars have previously been selected for display, the toggle function will turn them off. If all radars are actively off, the toggle function will turn on the radars effective at the selected aircraft altitude.

The Airborne Warning and Control System Polygon on/off button controls the display of AWACS orbit areas. When on, the AWACS polygons are displayed. Control of the AWACS polygons display is also available on Display Corridors dialog from the Corridors/Region function on the Overlays pull-down menu. This alternative display control has the added feature of color specification. AWACS polygons are displayed at the beginning of a session by default to remind the user that they exist.

The Keepout Area on/off button controls the display of geographic penalty zones such as neutral countries. When on, the Keepout Area polygons are displayed. Control of the Keepout Area polygons is also available on the Display Corridors dialog from the Corridors/Region function on the Overlays pull-down menu. This alternative display control has the added feature of color specification. Keepout Area polygons are displayed at the beginning of a session by default to remind the user that they exist.

4.3.2.3 Results. The user displays the selected threat type subset and attributes by clicking on the “OK” button at the bottom of the dialog. The Threat dialog will disappear and the desired threat background will be displayed in the drawing area. As a minimum, the Threats Displayed attribute must be set to “ALL” and an altitude must be selected for threats to be displayed at the beginning of a session. To back out of the Threat dialog without changing any attributes, the user clicks on the “Cancel” button. The Threat dialog will disappear, and the original threat background will be displayed.

4.3.3 Targets

4.3.3.1 Purpose. The Targets function on the Overlays pull-down menu displays the Display Targets dialog, Figure 4.3.3.1-1. This dialog allows the user to display all or a subset of the targets contained in the session’s target database.

Figure 4.3.3.1-1

4.3.3.2 Execution. The Associated with Route option is preceded by an on/off button. This option controls the display of all targets associated with the current route. When the button is depressed, the option is turned on (and the All by Country Code button is turned off).

The All by Country Code option is preceded by an on/off button. This option controls the display of all targets selected in the Country Codes column. When the button is depressed, the option is turned on (and the Associated with Route button is turned off).

The Country Codes list reflects the countries for which targets exist within the target database. By selecting a two character country code, the user displays a subset of targets restricted to the targets which contain that two character country code. Multiple country codes can be selected.

Toggle Country Codes. If targets have previously been selected for display in the Country Code column, the Toggle Country Codes function will turn them off. If all targets are currently off in the Country code column, the toggle function will turn on all targets.

Display Terrain Masks. A target mask shades the area in which a target is visible to the aircraft. This on/off option allows the user to display the appropriate target mask around each target displayed. This attribute is aircraft altitude dependent, and will vary as different altitudes are selected (in the Threats dialog).

Once the desired subset of targets is defined, the user selects the “Ok” button to refresh the background display with the desired targets and target masks and close the dialog. The “Cancel” button closes the dialog returns the user to the original background display.

4.3.3.3 Results. Target symbols are displayed on the drawing area.

4.3.4 Ground Stations

4.3.4.1 Purpose. The Ground Stations function on the Overlays pull-down menu displays the Display GDT dialog, Figure 4.3.4.1-1. This dialog allows the user to display all or a subset of the GDTs contained in the session’s GDTs database.

4.3.4.2 Execution Select Ground Stations from the Overlays menu. The choices for displaying GDTs are: none, all, or those associated to the current route. To display no GDTs the All button must be off and the Associated with Route button must be off. The user may choose the option of displaying Terrain Masks. The altitude band on the threat menu will be used to control the display of the terrain masks. To apply changes select the “Ok” button, and the dialog will be closed. To abort, select “Cancel”.

4.3.4.3 Results. GDT symbols are displayed on the drawing area.

Figure 4.3.4.1-1

4.3.5 Toggle Airbases

4.3.5.1 Purpose. The Toggle Airbases function allows the user to turn on or turn off the display of airbase symbols on drawing area.

4.3.5.2 Execution. To toggle the display of airbases, select Toggle Airbases from the Overlays menu.

4.3.5.3 Results. If airbases were previously displayed, then they will no longer be displayed. If airbases were not previously displayed, they will be displayed. When the zoom level is close enough, the airbases IDs will also be displayed.

4.4 Router Pull-down Menu

The Router pull-down menu, Figure 4.4-1, provides access to the Route, Finalize Vertical Route (FVR) and Clearance functions.

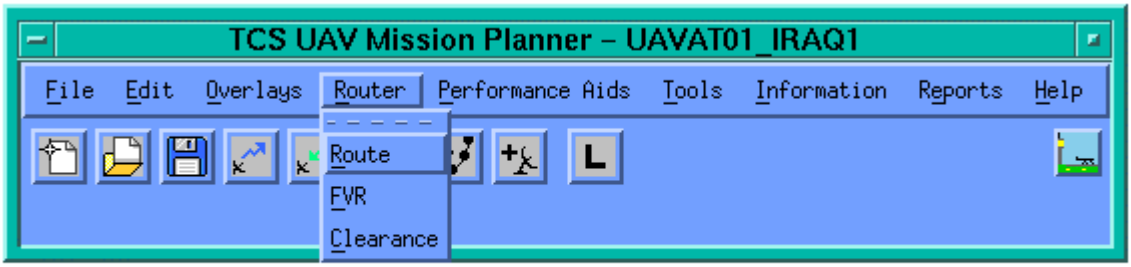

Figure 4.4-1

4.4.1 Route. Flight simulation and Low Observable (LO) Router functions.

4.4.1.1 Purpose. The Route function provides the user with an interactive router call for complete routes or route segments. The router can be restricted to the flight simulation mode or to full Low Observable routing. In addition, the LO Router can have up to eight options applied, including three dimensional routing.

4.4.1.2. Execution. The user defines a segment to be routed by identifying the segments initial and end points. The segment may be as large as the entire flight from takeoff to landing point, or as small as adjacent points that are logically connected (with a dashed line). The segment to be routed may contain routed sub-segments, however, some portion of the segment must be unrouted (a segment becomes unrouted whenever a point is edited). If the selected segment has no unrouted parts, the Router Setup Error message is displayed, Figure 4.4.1.2-1. Either the “OK” or the “Cancel” button will close the Router Setup Error dialog and the Router pull-down menu.

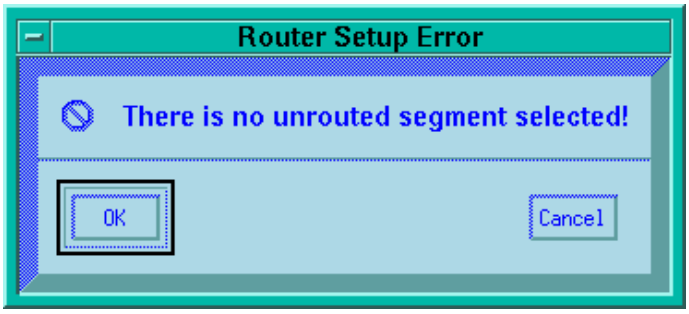

Figure 4.4.1.2-1

Any routed segments that exist between the initial point and the end point of the defined segment will not be re-routed but will be included in flight simulation for fuel, time and exposure calculations. With the segment defined, initial and end points selected, select Route from the Route pull-down menu. If no segment is defined, a warning message is displayed in

the Planner message area, otherwise the Router Options dialog, Figure 4.4.1.2-2, will be displayed.

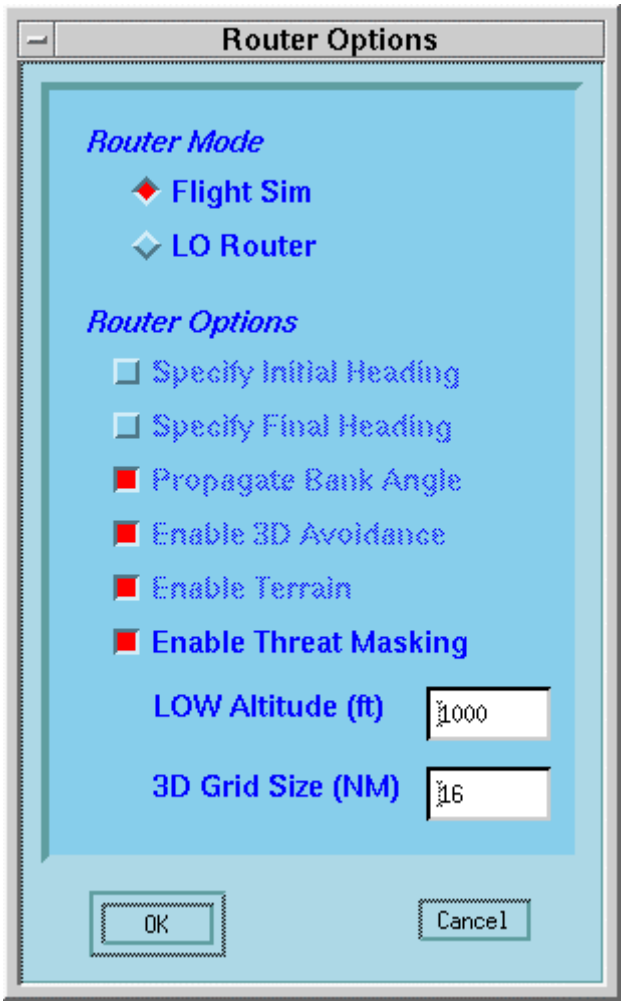

Figure 4.4.1.2-2

The Flight Sim button activates point to point routing including the completion of turns and altitude changes. Fuel and time calculations are performed, taking into consideration aircraft performance.

LO Router computes the minimum threat exposure route between each pair of points. The router attempts to stay within range of GDTs associated to the route. Additionally, the router tries to avoid restricted areas such as keepout zones. LO Router also executes flight simulation and vertical route refinement. The router does not move user entered points, however, it does insert calculated points as necessary to complete the route. **Note**: The greater the distance between two adjacent points, the greater chance the router will have to successfully complete the route.

The Router Options currently selectable are restricted to Enable Threat Masking. This option allows the LO Router to use the preprocessed threat masks to minimize threat exposure If

threat masking is not turned on or masks are not available, the radars are assumed to have bald earth line-of-sight capability.

The router status button on the Planner Toolbar changes from a static display to animation when the router is executing.

The "OK" button closes the Router Options dialog and executes the router in the background. The "Cancel" button closes the Router Options dialog and the Router pull-down menu without executing the router.

4.4.1.3 Results. When the router function completes the Router Status message, Figure 4.4.1.3-1, is displayed notifying the user that the router has completed and the router execution time. The "OK" button closes the Router Status message.

When no routing errors occur, the routed segment is displayed as a solid line connecting each point. If a routing error occurs, the segment in error is displayed as a solid white line or a dashed line. The dashed line indicates a significant problem preventing the router from generating a viable route. The solid white line indicates a route problem which can be corrected. **Note**: A route containing any dashed line segment cannot be uploaded to the UAV.

If routing errors occur, the user should generate the Error Report (see Reports) for specific details or run Validity check from the Tools pull-down menu.

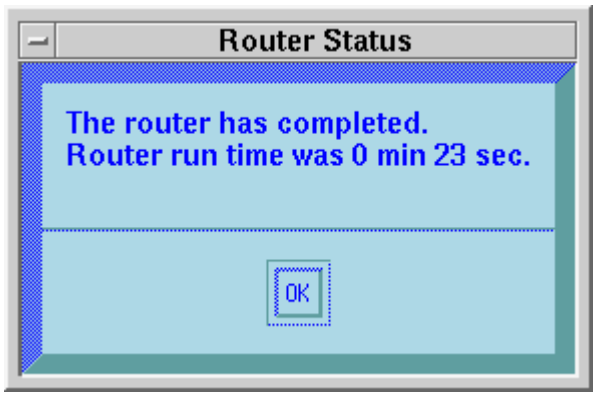

Figure 4.4.1.3-1

4.4.2 Finalize Vertical Route (FVR)

4.4.2.1 Purpose. After a mission has been successfully routed, the function Finalize Vertical Route (FVR) must be run to recompute performance (i.e., fuel and time enroute) and exposures for the entire sortie. FVR always runs against the entire mission (the user need not select begin and end points), recalculates all cumulative values and re-evaluates the sortie for exposure.

4.4.2.2 Execution. Select FVR from the Router pull-down menu. The FVR Options Dialog, Figure 4.4.2.2-1, opens with two options. The "OK" button will remove the dialog and display the message "FVR started" in the Planner message area. The "Cancel" button removes the dialog without executing the FVR and closes the Router pull-down menu.

Figure 4.4.2.2-1

The Enable Terrain button allows FVR to calculate an MSL flight profile for segments with a vertical flight condition using terrain data. If this option is not selected, the route profile assumes a bald earth.

The Enable Threat Masking button allows the use of preprocessed terrain masks to minimize exposure during the FVR call. If threat masking is not enabled or if masks have not been generated, radars are assumed to have bald earth line-of-sight capability.

If there are unrouted segments, a message to that effect is displayed, Figure 4.4.2.2-2. Either the “OK” or the “Cancel” button will close the message window and the Router pull-down menu.

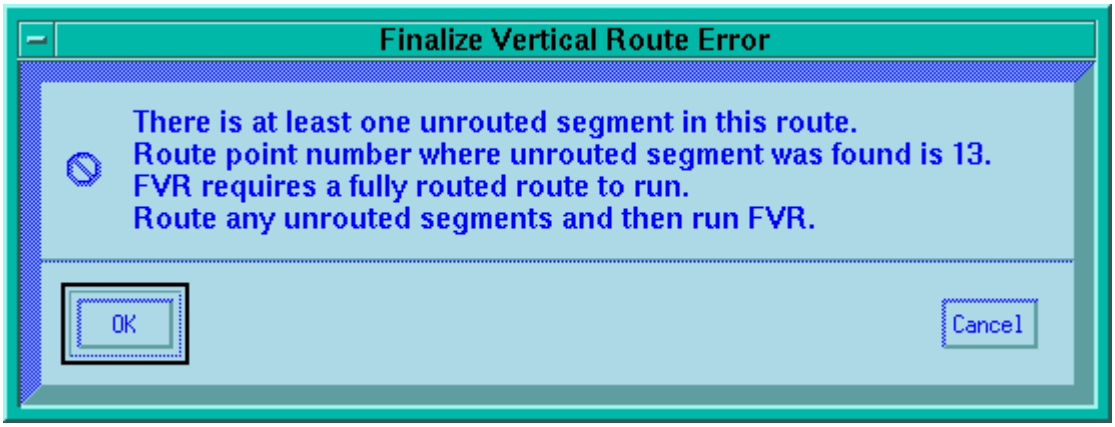

Figure 4.4.2.2-2

4.4.2.3 Results. Finalize Vertical Route will update cumulative values of fuel remaining, distance traveled, estimated time enroute, and gross weight. The FVR Status window, Figure 4.4.2.3-1, is displayed indicating if errors were discovered or not. The “OK” button closes the FVR Status window.

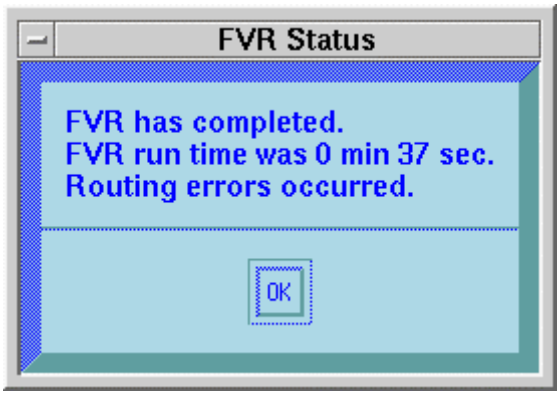

Figure 4.4.2.3-1

4.4.3 Clearance.

4.4.3.1. Purpose. Clearance calculates the minimum and maximum terrain clearance for the entire route. The primary function is to identify route segments where terrain clearance is marginal or unsafe.

4.4.3.2 Execution. To run Clearance, select Clearance from the Router pull-down menu. The Clearance Processing Dialog, Figure 4.4.3.2-1, is displayed while the process is running. The minimum and maximum terrain clearance is calculated over the flight corridor for each point of the route.

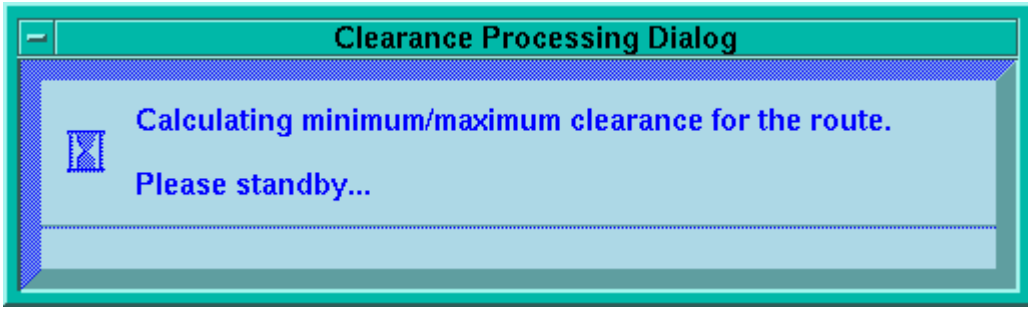

Figure 4.4.3.2-1

4.4.3.3 Results. The results consist of the minimum terrain clearance altitude and associated point, followed by the maximum terrain clearance altitude and its associated point displayed in Clearance Calculation Results, Figure 4.4.3.3-1. If the minimum clearance is below the terrain elevation, the Clearance Calculation Results will include a negative AGL associated with each point of impact. The “OK” button closes the Clearance Calculations Result message. Clearance should always be run before the final version of the route is saved.

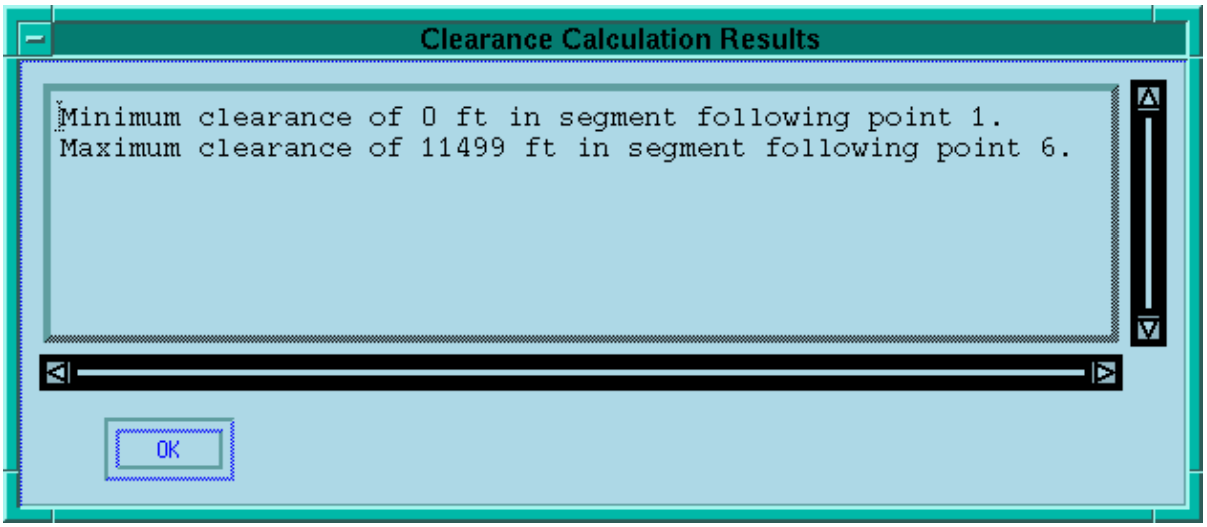

Figure 4.4.3.3-1

4.5 Performance Aids Pull-down Menu

The Performance Aids menu provides tools to help the user evaluate and construct the mission.

4.5.1 Flight Profile

4.5.1.1 Purpose. The Flight Profile function, Figure 4.5.1.1-1, presents a vertical profile of both the route of flight and the underlying terrain elevation within the route corridor. This performance aid assists the user in locating segments in which terrain clearance is insufficient, or in assessing terrain clearance for MSL segments. The Router's Clearance function also identifies terrain clearance problems and can be run in lieu of Flight Profile.

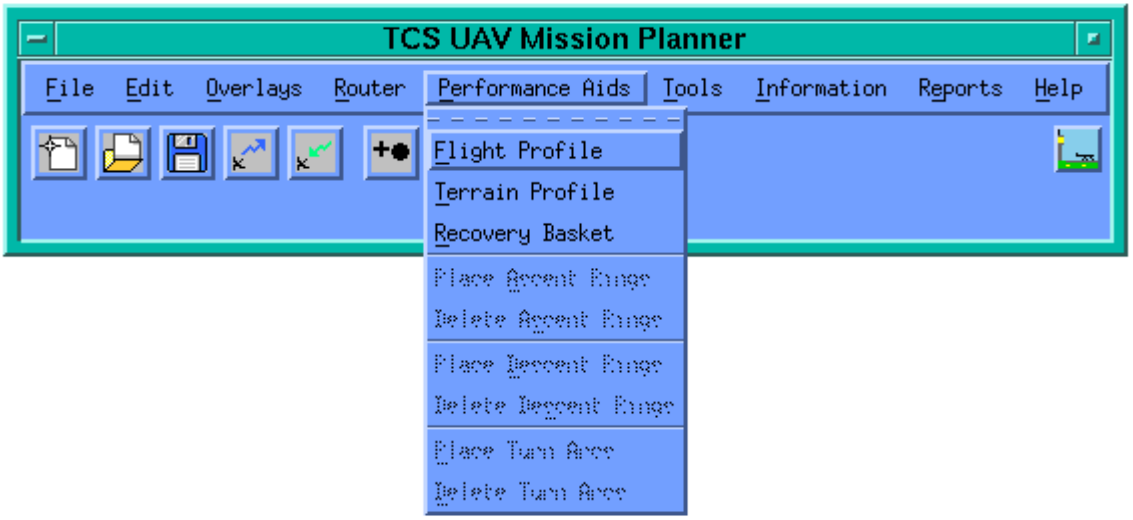

Figure 4.5.1.1-1

4.5.1.2 Execution. To run Flight Profile, open a route and select Flight Profile from the Performance Aids pull-down menu. When no route points are selected, a flight profile for the entire route, from takeoff to landing, is generated. When one route point is selected, a flight profile extending from the single point to the landing is generated. When a segment is selected, the flight profile for the segment is generated.

4.5.1.3 Results. The Flight Profile panel, Figure 4.5.1.3-1, consists of text readouts, a profile graph and the graph display zoom controls and pan scrollbars. The text readout on the left side of the panel contains latitude, longitude, terrain elevation and flight elevation in both MSL and AGL for any point on the graph designated with the pointer. When the pointer is outside the graph all text readouts are “N/A". If terrain data is not available for the designated point, the terrain elevation and AGL altitudes will be N/A.

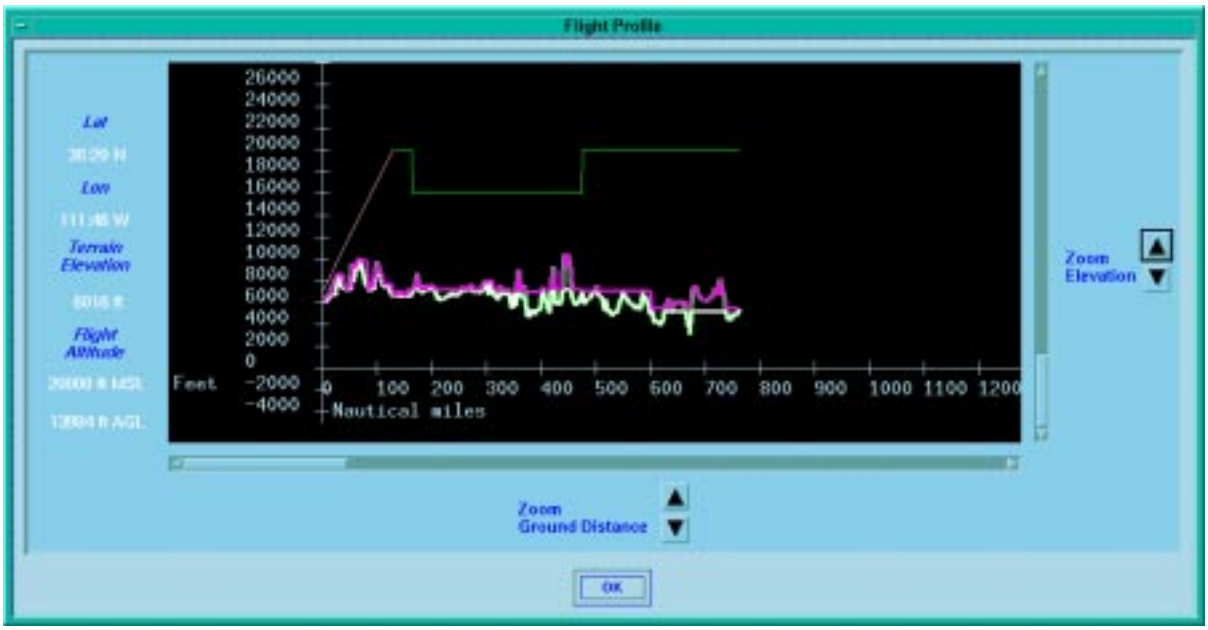

Figure 4.5.1.3-1

The graph consists of segment distance in nautical miles along the horizontal axis, and MSL altitude in feet along the vertical axis. Displayed on the graph is a line representing the aircraft’s vertical profile (green, with pink for ascent and plum for descent segments) and three lines representing the maximum terrain within the mission corridor width (purple), the minimum terrain within the mission corridor width (white), and the terrain under the flight path (green). A terrain clearance problem exists when the aircraft’s vertical profile intersects the terrain vertical profile maximum or comes within the minimum clearance defined on the Mission Parameters dialog. Gaps in the terrain vertical profile indicate areas where terrain data (DTED) is unavailable. The area of the route segment displayed on the graph can be panned using the horizontal scrollbar and zoomed using the Zoom Ground Distance buttons. The altitude band displayed on the graph can be panned using the vertical scrollbar and zoomed using the Zoom Elevation buttons.

4.5.2 Terrain Profile.

4.5.2.1 Purpose. The Performance Aids menu, Terrain Profile function provides the user with a method to determine the terrain elevation at any location on the drawing area for which DTED is available.

4.5.2.2 Execution. To execute this function, select Terrain Profile from the Performance Aids menu. The user will be prompted to drag a line on the drawing area under which the desired terrain exists. After the user drags this line, the Terrain Profile window, Figure 4.5.2.2-1, will be displayed. To exit from the Terrain Profile window select the "OK" button.

A line, representing the line-of-sight (LOS) from the initial point to the last point of the drawn line may be displayed by changing the default "initial elevation" and "final elevation" values.

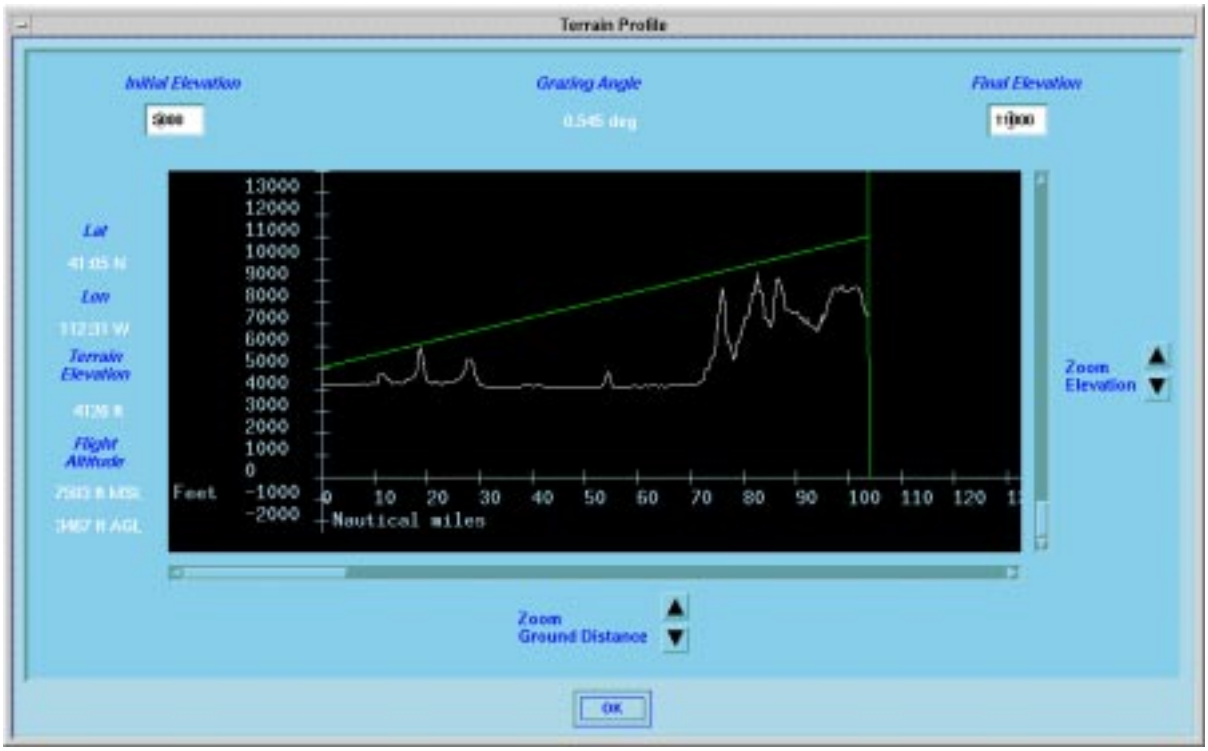

Figure 4.5.2.2-1

4.5.2.3 Results. The Terrain Profile panel consists of LOS initial and final elevation fields, grazing angle (LOS angle from the horizon), text readouts, a profile graph and the graph display zoom controls and pan scrollbars. The text readout on the left side of the panel contains latitude, longitude, terrain elevation and flight altitude, MSL and AGL, for any point on the graph designated with the pointer. When the pointer is outside the graph all text readouts are "N/A". If terrain data is not available for the designated point, the terrain elevation and AGL altitudes will be N/A. The terrain profile is displayed. The graph consists of segment distance in nautical miles along the horizontal axis, and MSL altitude in feet along the vertical axis. Displayed on the graph is a line representing the terrain elevation under the

line drawn by the user. The LOS line is displayed in green until the line intersects the terrain, where it turns to red.

4.5.3 Recovery Basket.

4.5.2.1 Purpose. The Recovery Basket provides the user with a graphical depiction of the maximum distance the Air Vehicle can travel, based on fuel remaining, including the required reserve fuel.

4.5.3.2 Execution. Select a route point and then the Recovery Basket function from the Performance Aids menu to turn the recovery basket display on or off.

4.5.3.3 Results. If the recovery basket is off (no circle displayed), selecting the option causes display of the circular overlay (Figure 4.5.3.3-1), centered on the selected point. The circle defines how far the air vehicle can fly from the selected point, given the amount of fuel remaining (not including the reserve) at that point. If the fuel at the selected point is below the reserve, a message is displayed and the recovery basket will not be displayed.

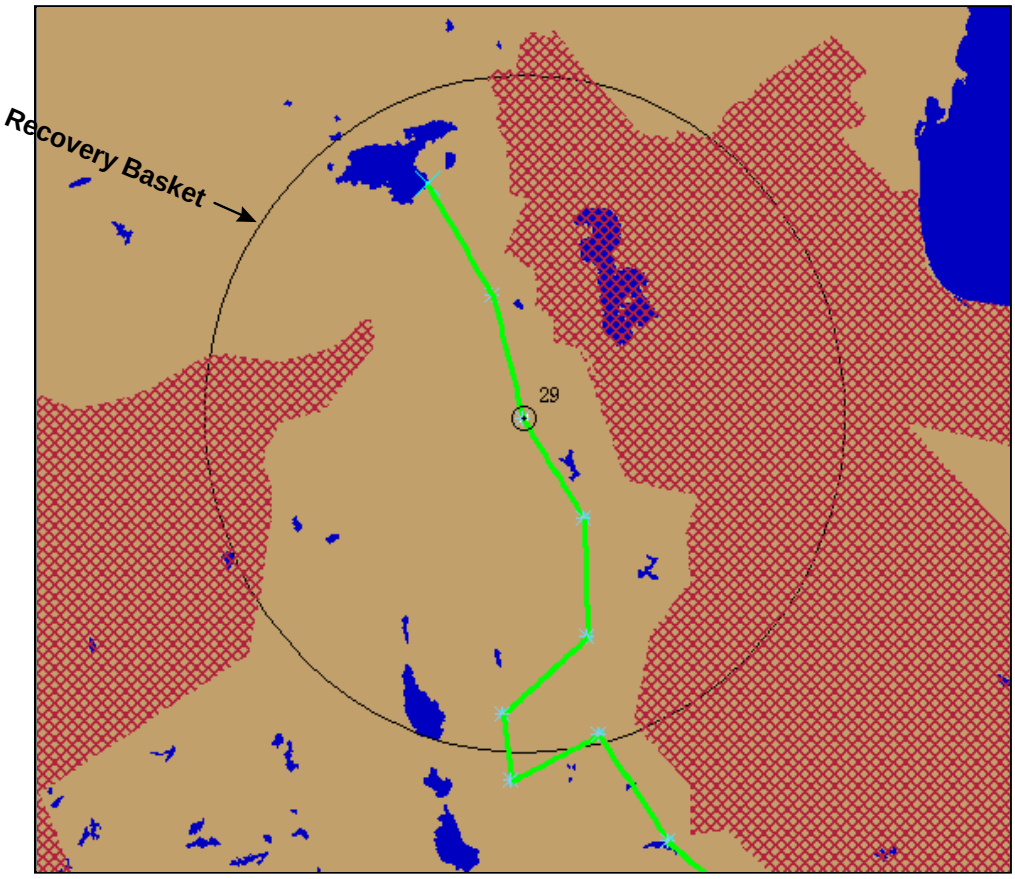

Figure 4.5.3.3-1

4.6 Tools Pull-down Menu

The Tools menu, Figure 4.6-1, provides the user with functions to display the air vehicle footprint relative to threats, payload sensor coverage, transfer mission plans between TCS and the planner, display route validity checks, set the coordinate system, find a target in the target database, generate threat, target, and GDT terrain masks, and edit the air vehicle defaults.

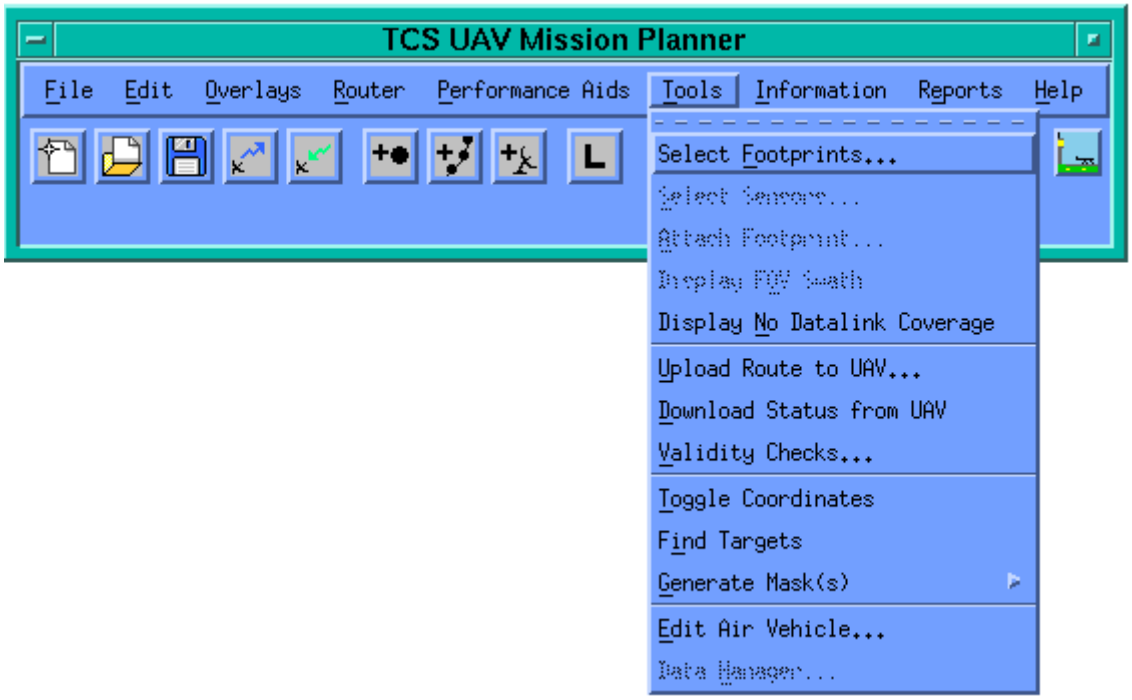

Figure 4.6-1

4.6.1 Select Footprints.

4.6.1.1 Purpose. The Select Footprint function, Figure 4.6.1.1-1, allows the user to evaluate the exposure to threats the vehicle may encounter and to turn on the display of sensor coverage footprints.

Threat footprints represent the aircraft's radar cross section as perceived by a specific threat when the aircraft is at a specific altitude and vertical flight condition. Up to four permutations of threat type, altitude, and vertical flight condition can be displayed at one time. Threat footprints allow the user to anticipate exposure and minimize it when manually planning a route.

The sensor coverage wedges (SCW) reflect the line-of-sight capability of the imaging systems and are used during the imaging maneuver to verify that the target(s) are within the field of view. Sensor footprints allow the user to evaluate the sensor Field of View (FOV) for imaging sequences.

When both SCW and Threats are selected, a composite SCW/Threat footprint will be displayed.

Figure 4.6.1.1-1

4.6.1.2 Execution. The Select Footprint function on the Tools pull-down menu displays the Select Footprints dialog which is used to define the Sensor Coverage and Threat footprint attributes. This dialog defines the footprint, but does not display it. To display the footprint, the user must execute the Attach Footprint function.

Sensor Coverage Wedge (SCW). Characteristics for the SCW include aircraft altitude and display color. The altitude characteristic allows the user to choose the appropriate aircraft altitude for determination of radar line-of-sight. The first button labeled “SCW:” reflects the active altitude selection and when activated, it displays a selection list consisting of available altitudes and “Off”. Any selection, other than “Off”, will make the SCW part of the composite. The SCW will be displayed at route points that have images associated with them. The SCW will be the sensor defined (EO, IR, SAR) for that image sequence. This is the same as the “automatic” mode on the Select Sensor dialog. The altitudes displayed represent bands of altitudes. Only one altitude can be selected. The second SCW button reflects the “Active Color” that will be used to display the wedges within the composite. When activated, it displays a list of color options. To change the color, the user selects a color from the entry list. The SCW displayed will be the sensor that is set in the route at the image point. Currently, the color selection does not affect the display.

Threat Footprints are threat type, aircraft altitude, and aircraft vertical flight condition specific. There are 350 threat types, 19 altitude bands, and five Vertical Flight Conditions (VFCs) for a total of 33,250 unique great circle contour footprint possibilities from which the user may choose up to four to create a composite footprint. The user designates the altitude, VFC, and threat type for a single footprint and adds it to the composite. If the altitude and/or VFC is the same for the next footprint to be added to the composite, these two variables do not have to be re-selected. To add a new footprint once the composite is full, the user must first delete one of the original four. Footprint colors match the colors assigned to the individual threat types.

The Display Footprint button allows the user to turn the threat footprint portion of the composite on or off. In the off position, the user can work exclusively with the SCW. In the on position the threat types that appear in the four Selected Footprint windows will be displayed as part of the composite.

The Selection Altitude button serves two purposes. First, when an altitude is selected, those threat types that are ineffective against the air vehicle at the selected altitude will appear desensitized on the scrollable lists of threat types. An ineffective threat cannot be added to the composite. Second, this button allows the user to specifically identify which contour will be added to the composite since there are possibly 19 contours for any given threat type VFC combination. The list of altitudes also includes an off option that will ghost all threat types.

Once the composite threat or sensor footprint is displayed, its movement is controlled by the selection on the Movement Mode button. In the route mode, the footprint will only follow the route of flight. The contours displayed are for the threat types and SCW specified by the user, but the VFC and altitude inputs are controlled by footprint's active location on the route. While the footprint is displayed in route mode, the user is provided a means to control the speed at which the footprint follows the route of flight and anytime the footprint reaches a point where the VFC and/or altitude change, the displayed threat type contours displayed will change to match. The route mode is used to analyze and validate the active route of flight.

Vertical Flight Condition (VFC). VFC is used in footprint generation to assign an aircraft pitch attitude. The VFC button lists the flight conditions used by the footprint preprocessor. The three VFCs are constant MSL altitude (CON), normal rate of climb (Ascend), and tactical rate of descent (Descend). In the route movement mode, the VFC and altitude attributes are determined by the route point at which the composite is attached.

Threat Types. The threat types are presented as two scrollable lists. The smaller list consists of weapon systems and the larger list is the radar types. The availability of individual threat types is controlled by the altitude selected and the number of threat types declared for the composite. When the user selects an altitude, threat types that are ineffective at that altitude will become desensitized. If the altitude selected is the "Off" option, all threat types will appear desensitized. As long as the VFC and altitude remain the same, the user may choose up to four effective threat types to be added at once to the Selected Footprint's list. Once four are selected, or the number selected and the number previously added equals four, all of the threat buttons will be desensitized. To select a fifth type, one of the four existing types must be deleted from the Selected Footprint's list. The buttons associated with effective threats become active again once the number of threats in the Selected Footprint's list is less than

four. Each of the possible threat types is preceded by an on/off button. If the button's color is the same as the color used for threat display, the threat type is selected for addition to the Selected Footprint's list. If the button's color is the same as the background color, the threat type is de-selected.

Selected Footprint's List. The Selected Footprint's list consists of four windows and three buttons that control what is displayed in those windows. The windows reflect the threat footprints chosen for inclusion in the composite footprint. The "Add Footprint" button becomes active when the user selects one to four threat types from the two scrollable lists. Selection of an active "Add Footprint" button adds the selected threat types to the Selected Footprint's list. Each footprint added will appear in a window with its name, altitude, and VFC color coordinated with its threat display color. Once all four windows are full, the add button will become desensitized and so will all the threat types. To delete a footprint from the Selected Footprint's list, the user clicks one or more Selected Footprint windows. When a Selected Footprint window is selected, the window's background color will assume the threat display color with black lettering and the "Delete Footprint" button will become active. The user cannot choose an empty Selected Footprint window. If the "Delete Footprint" button is selected while the button is active, all footprints with colored windows will be removed from the list. The "Modify Footprint" button is no longer used and will always remain desensitized.

4.6.1.3 Results. The "OK" button executes the Select Footprint function which builds a composite footprint based on the attributes chosen by the user on the Select Footprints dialog. The dialog will be removed and the original background display will be refreshed. The composite footprint or sensor footprint defined by this function is displayed by invoking the Attach Footprint function. The "Cancel" button removes the dialog without altering the previous composite footprint.

4.6.2 Select Sensors.

4.6.2.1 Purpose. The Select Sensors function displays the Sensor Select dialog, Figure 4.6.2.1-1, which allows the user to select the method of displaying SCWs. The user may select to turn off display of the SCW, automatically display the SCW at image points, or select up to four SCWs to be displayed at all points. This dialog also includes the Display FOV Swath Distance. This item determines the step size (distance between swaths) along the route at which the FOV Swaths are generated.

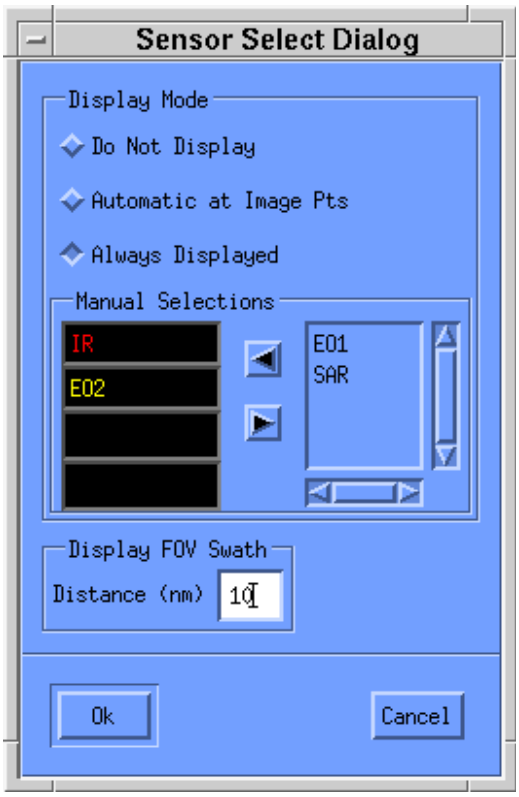

Figure 4.6.2.1-1

4.6.2.2 Execution. On execution of the "Do Not Display" button, SCWs will not be displayed at any point of the route. When "Automatic at Image Pts" is selected the SCW footprint will be displayed only at the imaging point. When "Always Displayed" is chosen, the "Manual Selections" will become available. Select the desired sensor to always be displayed and press the left arrow to move it to the display field. To remove a sensor from the display, select it in one of the four text fields and press the right arrow.

The Distance for the FOV Swath is set here. Enter the distance in nautical miles. Use the Display FOV Swath to see the results.

4.6.2.3 Results. The results of the sensor selections are graphically displayed when the Attach Footprint function is started (see below). The results of the FOV Swath Distance will be seen when the Display FOV Swath function is run.

4.6.3 Attach Footprint.

4.6.3.1 Purpose. If a composite footprint or sensor footprint has been defined using the Select Footprint function, the Attach Footprint function displays the footprint and controls its movement. The aircraft's position within the footprint is identified by the Air Vehicle symbol. The threat footprints displayed are contour footprints when the bank angle is zero, and turn footprints when the bank angle is greater than zero.

4.6.3.2 Execution. To attach a composite footprint or sensor footprint in the route mode, select a route point as the point of attachment. Next, select the Attach Footprint function on the Tools pull-down menu. The composite footprint will appear centered on the selected route point with a heading equivalent to the outbound heading for the next route segment.

Movement of the footprint in the route mode is controlled by the route of flight with a rate that is adjustable by the slider. A slider is a control used to set a value (in this case speed) and give a visual indication of the setting. The slider consists of a box on a cable. To adjust the rate of movement, position the pointer on the box and using the left mouse button drag box left or right to the desired rate before releasing. A numerical reference for the rate is printed immediately above the slider. When the numerical reference reaches zero, the composite footprint will hold its active position. A negative rate will force the composite footprint to traverse the route back toward the launch point while maintaining a forward looking heading. A positive rate causes the composite footprint to follow the route of flight towards the landing base. Positioning the pointer at the desired rate and clicking the middle mouse button will cause the slider to jump to the desired rate. As the composite footprint moves along the route of flight, the footprints displayed will change at each route point where the aircraft's altitude, VFC, or bank angle change. A color coordinated list of the active footprints and sensor coverage wedges being displayed is provided in the Active Footprint Display dialog. Figure 4.6.3.2-1 illustrates display of a sensor coverage wedge. Both the movement rate slider and the Active Footprint Display dialog can be repositioned on the screen. When the threat/sensor footprint reaches the end of the displayed route, it will automatically wrap around to the beginning of the displayed route and continue at the set rate.

The threat/sensor footprints will be defined by the VFC and altitude associated with the designated route point. If the sensor coverage wedge is set to "automatic", the display will show "SCW on". Otherwise the selected sensor names will be displayed.

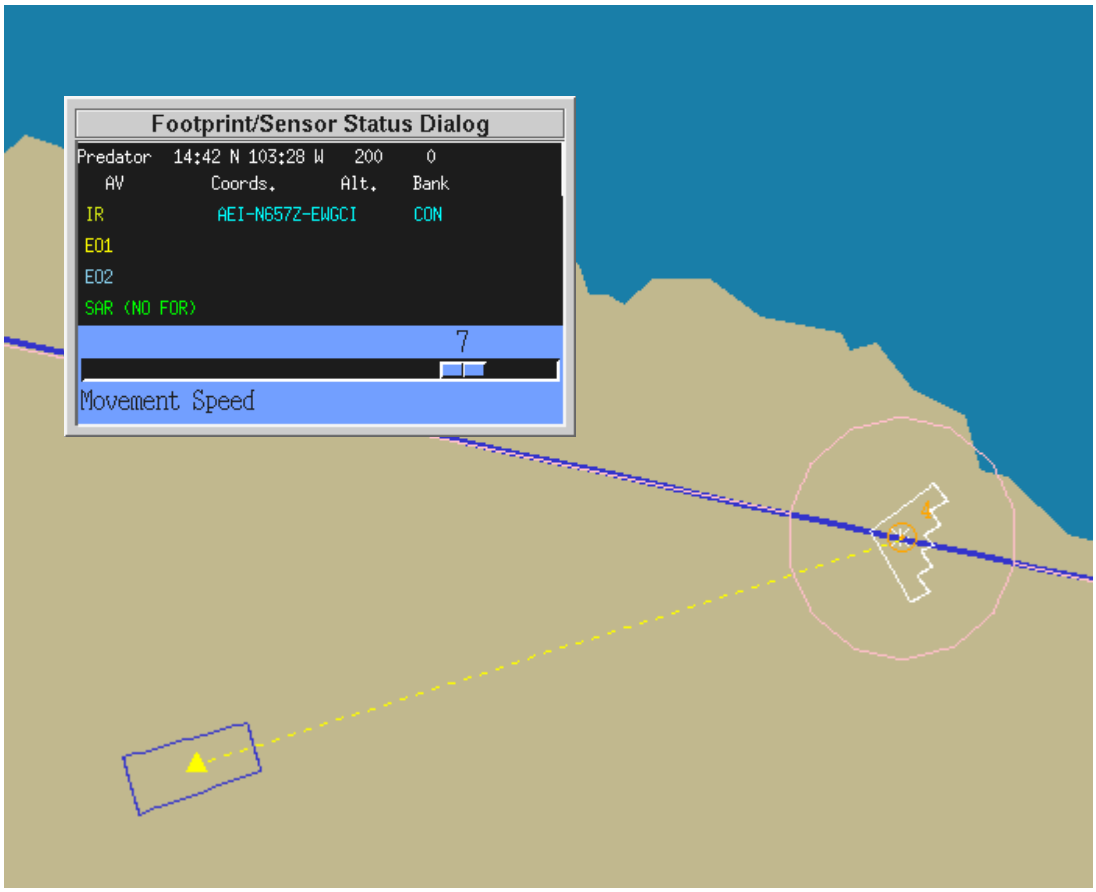

Figure 4.6.3.2-1

To exit the Attach Footprint function, re-select the Attach Footprint option on the Tools pull-down menu. The footprint will be removed from the drawing area but will remain available for attachment.

4.6.3.3 Results. When the threat footprint is in a turn, the great circle contours are replaced with the turn footprints appropriate for the turn's bank angle. The sensor coverage wedge display will be determined by what is selected in the Sensor Select Dialog. While executing the Attach Footprint function, all other GUI functions are desensitized.

4.6.4 Display FOV Swath.

4.6.4.1 Purpose. This function provides the user with a graphical display of all FOV swaths, as seen in Figure 4.6.4.2-1, (at a distance set on the Sensor Select Dialog) for the active route.

4.6.4.2 Execution. Select the Display FOV Swath function from the Tools pull-down menu. The value on the Sensor Select dialog will determine the resolution of the swath display.

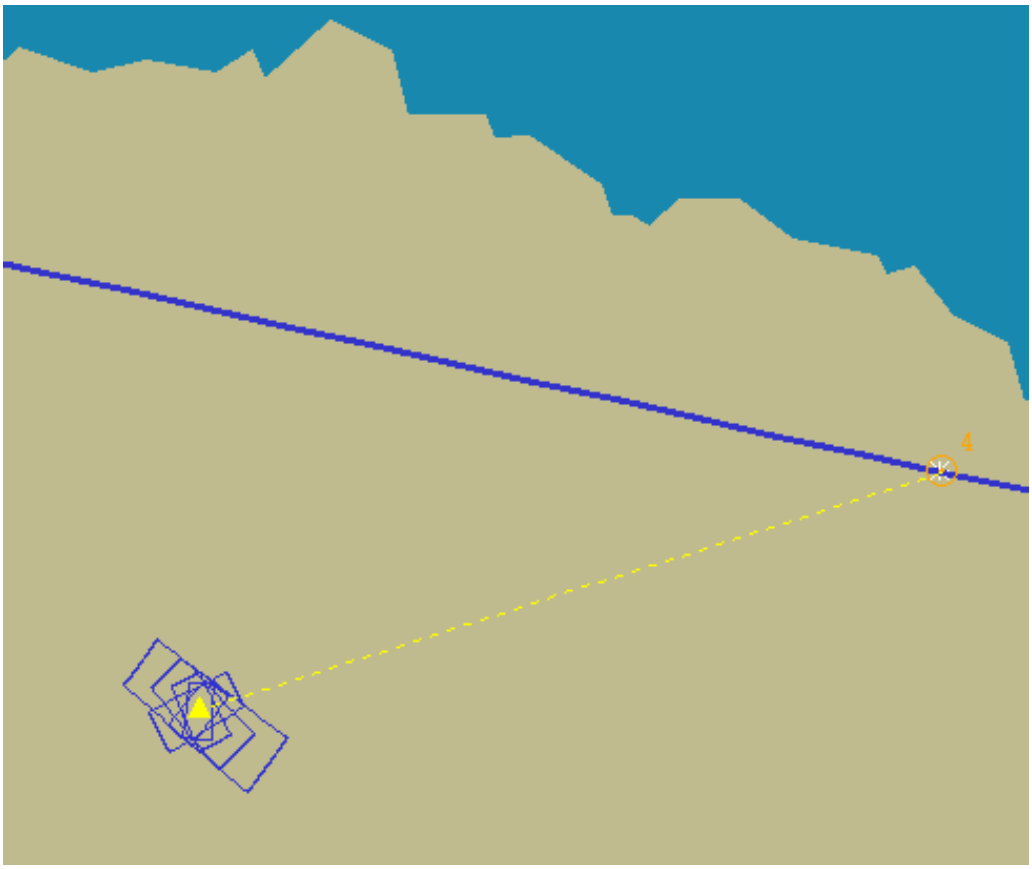

Figure 4.6.4.2-1

4.6.4.3 Results. The FOV is moved through all image sequences generating a "swath" that will be displayed. If the "swath" was already displayed, this option turns it off.

4.6.5 Display No Datalink Coverage.

4.6.5.1 Purpose. This function provides the user with a graphical depiction of route sections with no datalink coverage.

4.6.5.2 Execution. Select the Display No Datalink Coverage function from the Tools menu to turn on/off the display.

4.6.5.3 Results. A shaded area is displayed for parts of the route corridor which are not within datalink coverage. If the entire route is within datalink coverage, no additional shading is displayed. If the datalink coverage was already displayed, this option turns it off.

4.6.6 Upload Route to UAV

4.6.6.1 Purpose. The Upload Route to UAV function allows the user to notify TCS that the active route is ready to be uploaded.

4.6.6.2 Execution. To send an upload notification message, first open or create a mission, execute the router and FVR functions (the mission must be completely routed). Then execute the Upload Route to UAV function on the Tools pull-down menu. If the mission plan fails any

validation check, the Uplink Validity Checks dialog is displayed to inform the user of the failure(s). The dialog, Figure 4.6.6.2-1, contains a scrolled list of the errors and where in the route they occur. The user may override the errors and continue with the upload by selecting the “Yes” button. The “No” button is selected to cancel the upload and return with no action taken.

If the mission plan passes all of the validation checks, the Validity Check Status dialog is displayed informing the user that the mission will be uplinked.

The Upload Route Information dialog is displayed notifying the user of the success or failure of the upload. **Note**: The Data Server must be running prior to executing the Upload function.

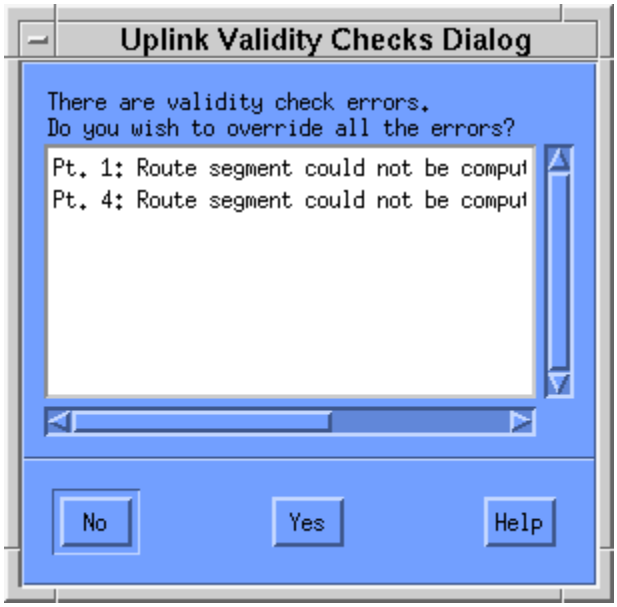

Figure 4.6.6.2-1

4.6.6.3 Results. Upon executing the Upload Route to UAV function, the mission plan files are created and stored for the Data Server to access for upload. A notification message is sent to TCS that the route is ready for upload.

4.6.7 Download Status from UAV

4.6.7.1 Purpose. The Tools menu, Download Status from UAV (Figure 4.6.7.1-1) function enables the user to obtain in-flight data from an active mission. The download data will include active location, altitude, heading, airspeed, ground speed, wind speed, wind direction, Estimated Time of Arrival (ETA) and fuel remaining.

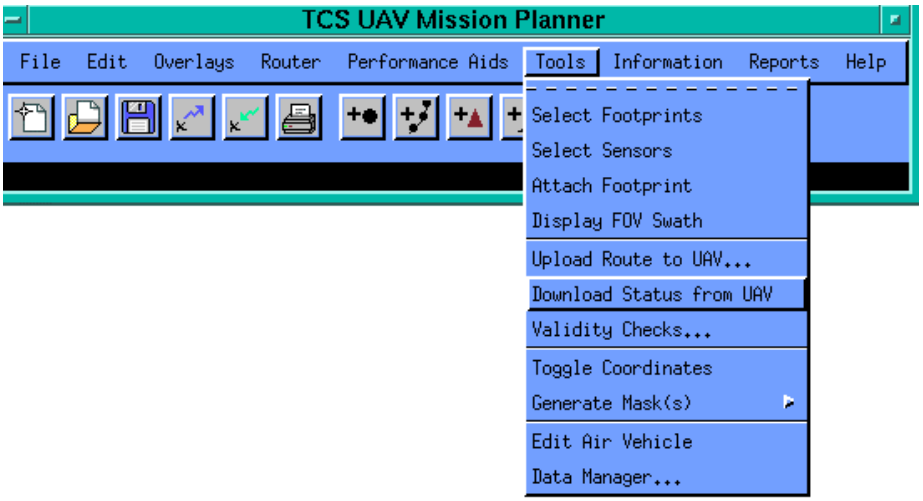

Figure 4.6.7.1-1

4.6.7.2 Execution. To obtain active mission status from an in-flight UAV, select the route point to which to attach the downloaded data. Then execute the Download Status from UAV function from the Tools pull down-menu. Alternatively use the download status hot button (indicated by a receiving dish and a green arrow pointing from the upper right toward the dish in the lower left).

Failure to select a point will result in the Download Status Error message “Select point at which to begin replan” being displayed, Figure 4.6.7.2-1. The “OK” or “Cancel” button will remove the message.

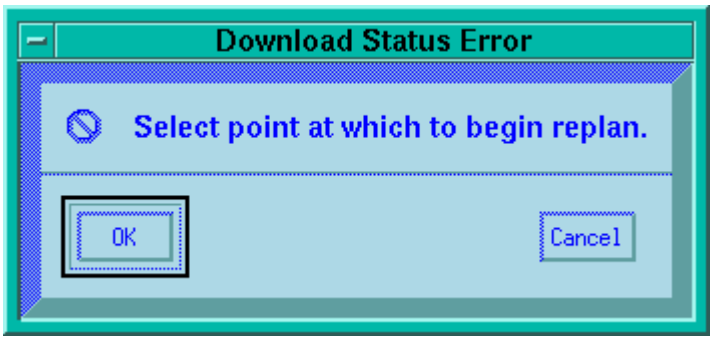

Figure 4.6.7.2-1

4.6.7.3 Results. All points prior to the selected route point will be removed. The downloaded data becomes the first (selected) point in the route.

4.6.8 Validity Checks

4.6.8.1 Purpose. Validity Checks allows the user to ensure the consistency and completeness of mission data in terms of sequences of points. This includes failure to clear terrain and attempted AV actions outside the performance envelope.

4.6.8.2 Execution. To run Validity Checks for a flight which has been fully routed, select Validity Checks from the Tools pull-down menu.

4.6.8.3 Results. If there is no active route or if any segments of the flight have not been routed, the Validity Checks Error dialog will be displayed. Otherwise, the Validity Checks Dialog, Figure 4.6.8.3-1, will display any detected problems. The “Close” button closes the Validity Checks dialog.

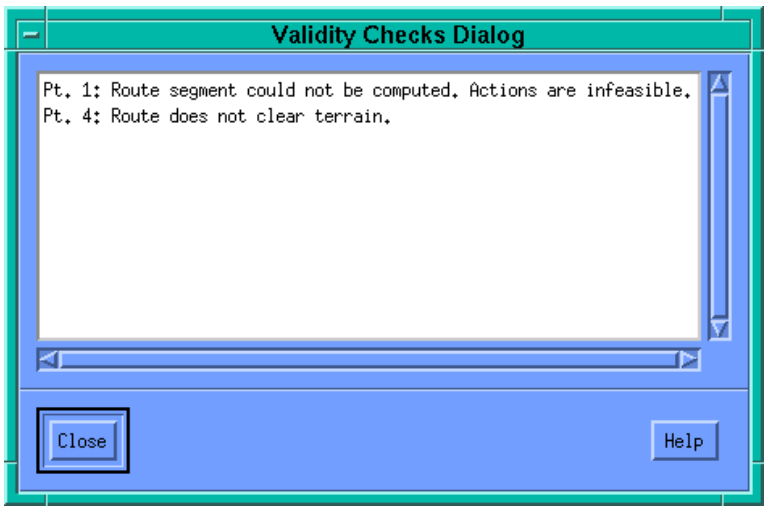

Figure 4.6.8.3-1

4.6.9 Toggle Coordinates.

4.6.9.1 Purpose. The Toggle Coordinates function allows the user to change the system of coordinates displayed on all dialogs. The Toggle Coordinates function does not allow the user to change the system of coordinates for the drawing area controlled by JMTK. The choices for systems of coordinates are Lat/Lon, MGRS, and UTM.

4.6.9.2 Execution. To change the coordinate system, the user may select Toggle Coordinates from the Tools pull-down menu, or click on the Toggle Coordinates hot button.

4.6.9.3 Results. Coordinates for all applicable dialogs will be displayed using the selected system of coordinates. The Toggle Coordinates hot button will display “L” if the active system is Lat/Lon, “M” if the active system is MGRS, and “U” if the active system is UTM.

4.6.10 Generate Mask(s)

4.6.10.1 Purpose. The Generate Mask(s) function, Figure 4.6.10.1-1, allows the user to generate terrain masks for the overlay objects; GDTs, targets, targets on the route, and threats. A mask must be generated whenever a new object is created or an existing object location is modified. The masks may be generated by type, or all at once. The user may also want to generate masks when new Digitized Terrain Elevation Data is available.

Since targets which are not in the database can be specified for imaging, this is the only way to generate terrain masks for such targets. This can also reduce computer processing time by limiting the number of masks generated.

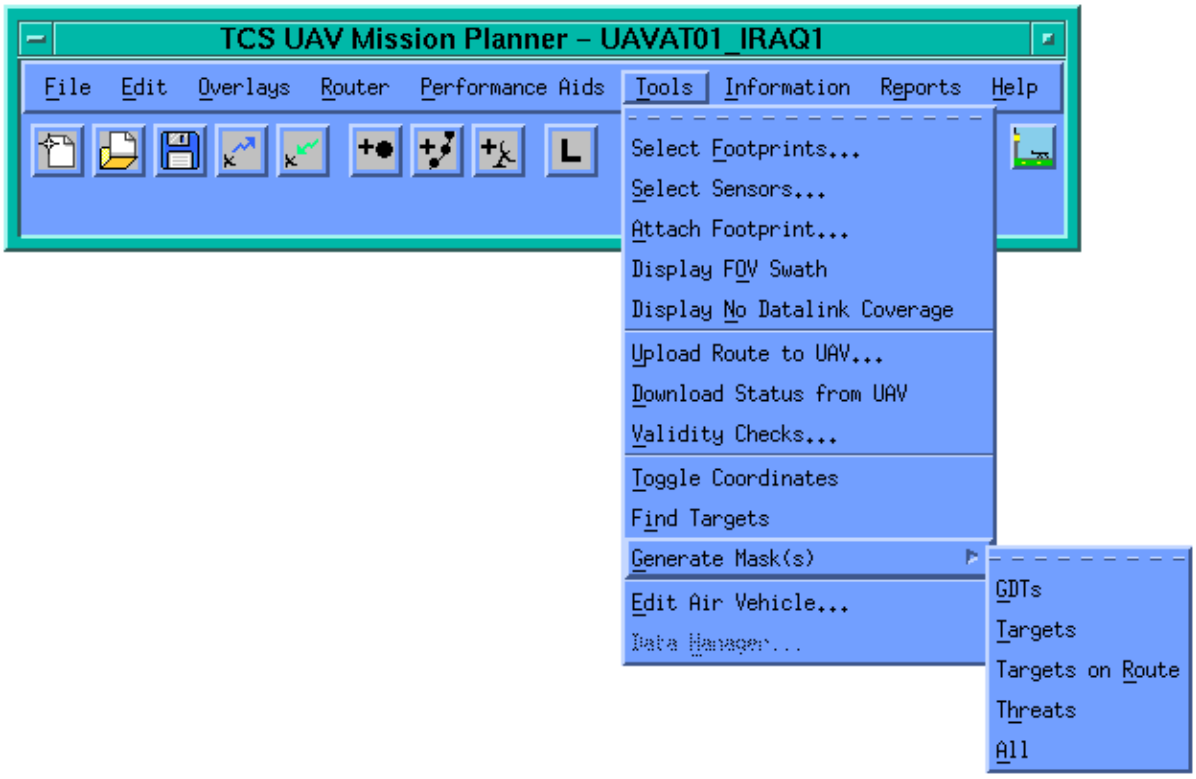

Figure 4.6.10.1-1

4.6.10.2 Execution. Masks may be generated using Level 1 DTED (raw) or compressed DTED. Currently only the compressed DTED is available. Upon selecting an item to generate masks, the Mask Processing dialog, Figure 4.6.10.2-1, is displayed, prompting the user for confirmation to continue using compressed DTED.

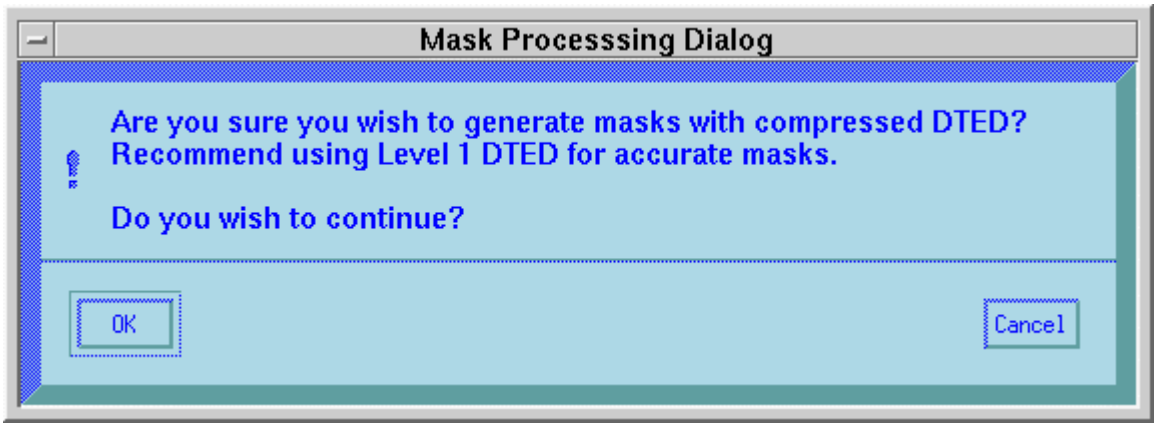

Figure 4.6.10.2-1

4.6.10.3 Results. Selecting the “OK” button starts the mask generation for the selected item(s). The “Cancel” button cancels the function and removes the Mask Processing dialog.

4.6.11 Edit Air Vehicle.

4.6.11.1 Purpose. The Edit Air Vehicle function allows the user to create and modify the characteristics of an air vehicle (AV configuration).

4.6.11.2 Execution. To change the default background data for an air vehicle, select Edit Air Vehicle from the Tools pull-down menu. The Air Vehicle Selection Dialog, Figure 4.6.11.2-1 will be displayed.

Figure 4.6.11.2-1

The “Air Vehicle Type” option menu button allows selection of the type of AV. This selection alters the “Available Configurations” area.

The “Available Configurations” list displays the current AVs and allows selection of a configuration for editing.

The “New Configuration” text box allows the user to create an identifier of an AV configuration to be defined. This works in conjunction with the New button.

The “Delete” button removes the AV configuration of the AV highlighted in the “Available Configurations” list. The “Cancel” button closes the Air Vehicle Selection Dialog without opening the Aircraft characteristics Dialog.

The “Edit” button opens the Aircraft Characteristics Dialog, Figure 4.6.11.2-2, for the AV highlighted in the Available Configurations list. The Aircraft Characteristic Editor message “Initializing data. Please wait…” will be displayed.

The “New” button opens the Aircraft Characteristics Dialog for the new AV type identified in the “New Configuration” text area. If the text area is blank, the Aircraft Characteristics Editor Error dialog will be displayed.

The Aircraft Characteristics Editor dialog consists of four tabs: General, Define Levels, Rate Tables, and Fuel Tables. The General dialog allows the user to define general characteristics of the vehicle such as its weight, payload, and speed. The Define Levels dialog allows the user to establish the altitudes, weight, and speed which will be used in the Rate and Fuel tables. The Rate Tables dialog allows the user to define altitude change loss or gain rates. The Fuel Tables dialog allows the user to define the fuel burn rate for the air vehicle.

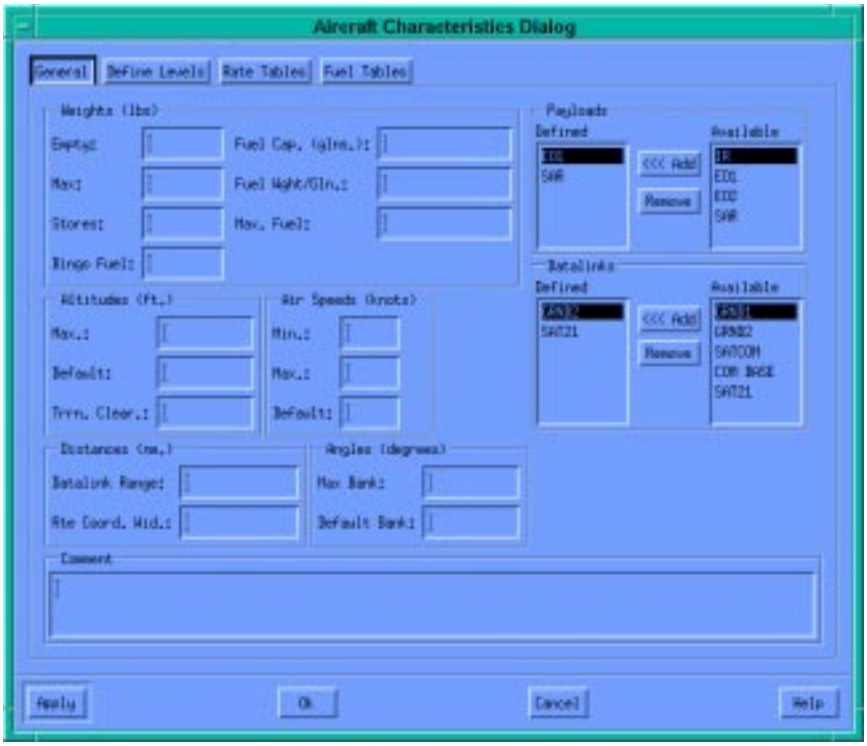

Figure 4.6.11.2-2

The “Apply” button saves the values (but does not apply the values to existing missions which may use this vehicle) in the Aircraft Characteristics dialog and leaves the dialog open. The “Ok” button saves the values in the Aircraft Characteristics dialog and closes the dialog. The “Cancel” button closes the Aircraft Characteristics Dialog without saving changes (which have not yet been “applied”).

1. General Tab.

   Weights:

   “Empty” text box defines the weight of unloaded vehicle in pounds.
   “Max” text box defines the maximum weight for loaded vehicle in pounds.
   “Stores” text box defines the non-fuel load with maximum fuel in pounds.
   “Bingo Fuel” text box defines the reserve fuel in pounds.

"Fuel Cap" text box defines the fuel tank capacity in gallons.
"Fuel Wght" text box defines the unit weight of fuel in pounds/gallon.
"Max. Fuel" text box defines the maximum fuel weight in pounds.

Payloads (currently not utilized by the program):

"Defined" is a list of the payloads installed on this aircraft.
"Available" is a list of possible payloads for this aircraft.
"<<<Add" button moves a highlighted payload in "Available" list to "Defined" list.
"Remove" button removes a highlighted payload from the "Defined" list.

Altitudes:

"Max" text box defines the maximum cruise altitude in feet.
"Default" text box defines the default cruise altitude in feet.
"Trrn. Clear" text box defines the minimum terrain clearance in feet.

Air Speeds:

"Min" text box defines the minimum air speed in knots.
"Max" text box defines the maximum air speed in knots.
"Default" text box defines the default air speed in knots.

Datalinks:

"Defined" is a list of the datalinks installed on this aircraft.
"Available" is a list of possible datalinks for this aircraft.
"<<<Add" button moves a highlighted datalink in "Available" list to "Defined" list.
"Remove" button removes a highlighted datalink from the "Defined" list.

Distances:

"Datalink Range" text box defines the maximum communication distance in nautical miles.
"Rte. Corr. Wid" text box defines the route corridor total width in nautical miles.

Angles:

"Max Bank" text box defines the maximum bank angle in degrees.
"Default Bank" text box defines the default bank angle in degrees.

2. Define Levels Tab, Figure 4.6.11.2-3: Define the specific values of altitude, weight and speed which will be used as bands in the Rate Tables and Fuel Tables matrices. **Caution**, changing these bands will require re-entering all performance data.

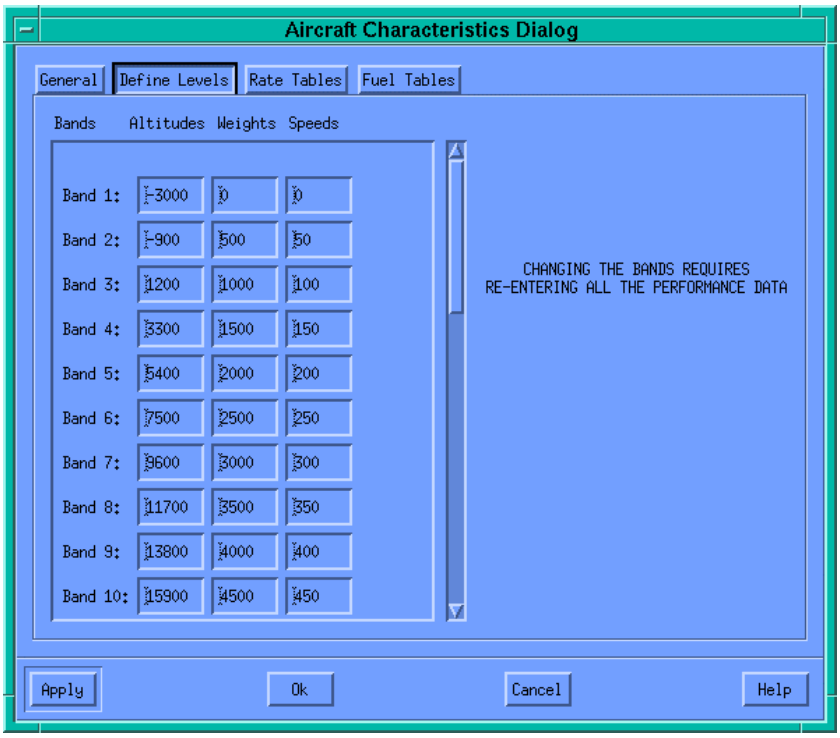

Figure 4.6.11.2-3

"Altitudes" text boxes define each altitude band to be used in the three dimensional Rate Tables and Fuel Tables matrices. Handles up to 30 altitude bands.

"Weights" text boxes define each weight band to be used in the three dimensional Rate Tables and Fuel Tables matrices. Handles up to 22 weight bands.

"Speeds" text boxes define the speed band to be used in the three dimensional Rate Tables and Fuel Tables matrices. Handles up to 22 speed bands.

2. 3. Rate Tables Tab, Figure 4.6.11.2-4: Define elevation loss or gain rates for specific combinations of weight, altitude, air speed and climb/descent.

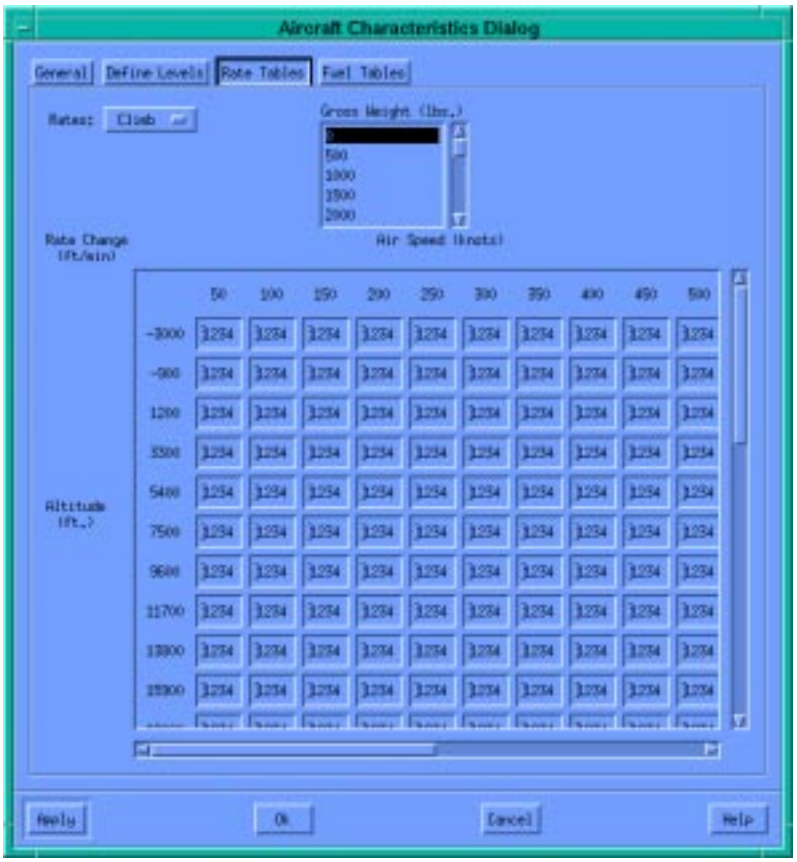

Figure 4.6.11.2-4

"Rates" option menu button allows for selection of Climb or Descent matrices. The selected option will appear on the button.

"Gross Weight" option window allows for selection of weight matrix coordinate.

"Rate Change" text boxes define the elevation gain or loss at specific weight, altitude and air speed points.

1. 4. Fuel Tables Tab, Figure 4.6.11.2-5: Define the rate of fuel burn for specific combinations of weight, altitude, air speed and aircraft maneuver.

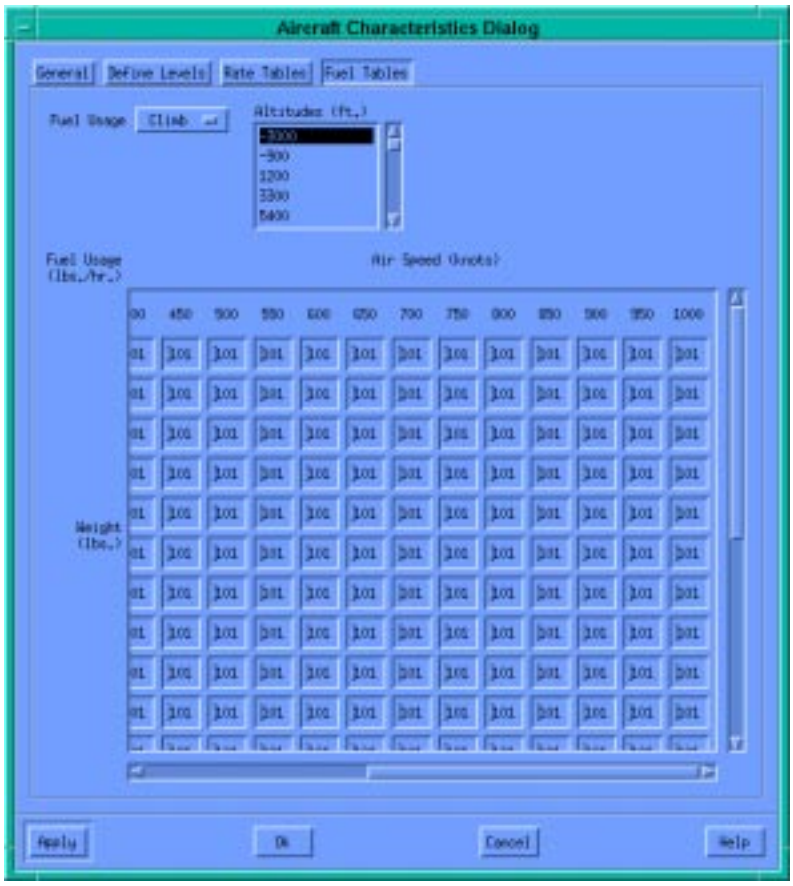

Figure 4.6.11.2-5

"Fuel Usage" option menu button allows for selection of Cruise, Climb or Descent matrices. The selected option will appear on the button.

"Altitude" option window allows for selection of altitude matrix coordinate.

"Fuel Usage" text boxes defines the fuel expended at specific weight, altitude, air speed and aircraft maneuver points.

4.6.12 Data Manager.

4.6.12.1 Purpose. TBD

4.6.12.2 Execution. TBD

4.6.12.3 Results. TBD

4.7 Information Pull-down Menu.

The Information pull-down menu, Figure 4.7-1, contains four functions that provide the user with text data.

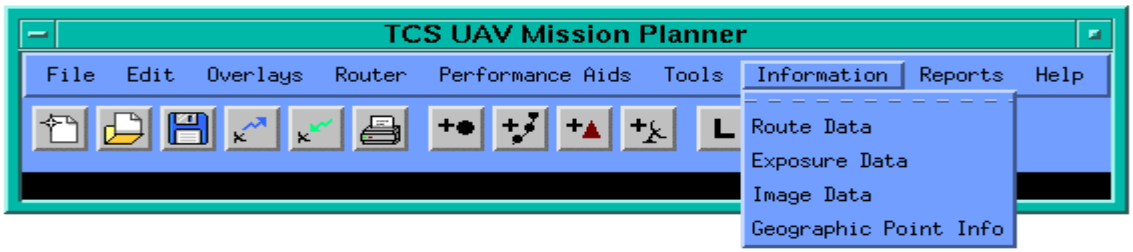

Figure 4.7-1

4.7.1 Route Point Data.

4.7.1.1 Purpose. The Route Point Data Information dialog, Figure 4.7.1.1-1, defines the referenced route point and the segment out of the referenced point. The data in the first column consists of route point number, route point latitude (dd:mm.mmm h), segment vertical flight condition (VFC), route point terrain elevation (feet), segment minimum terrain clearance altitude (feet AGL) if the Router function of Clearance has been executed, segment Mach, segment true airspeed (NM/hour), segment true course (degrees), segment drift angle (signed degrees), segment wind magnitude (NM/hour), fuel remaining at the referenced route point (lbs.), total weight of the aircraft at the reference point (lbs.), the penetration index (PI) at the start of the segment, total route length (NM) up to the reference route point, accumulated time (seconds) up to the reference route point, turn center latitude (dd:mm.mmm h) if referenced point is a start turn point, bank angle (degrees) if referenced route point is a start turn point, estimated time of arrival (hhmmss), estimated date of arrival (ddmmyy), and fuel degrade. The data in the second column consists of route point event type, route point longitude (ddd:mm.mmm h), aircraft MSL altitude at the referenced point (feet), aircraft AGL altitude at the referenced point (feet), maximum terrain elevation for the segment (feet), rate of altitude change for climb or descent segments (signed feet/NM), segment ground speed (NM/hour), segment true heading (degrees), segment ground track heading (degrees), segment wind direction (degrees), fuel consumed on the segment (lbs.), weight change for the segment (lbs. of fuel), PI change on the segment, segment length (NM), routed segment flag (true or false), turn center longitude (ddd:mm.mmm h) if referenced point is a start turn point, and turn radius (NM) if referenced point is a start turn point.

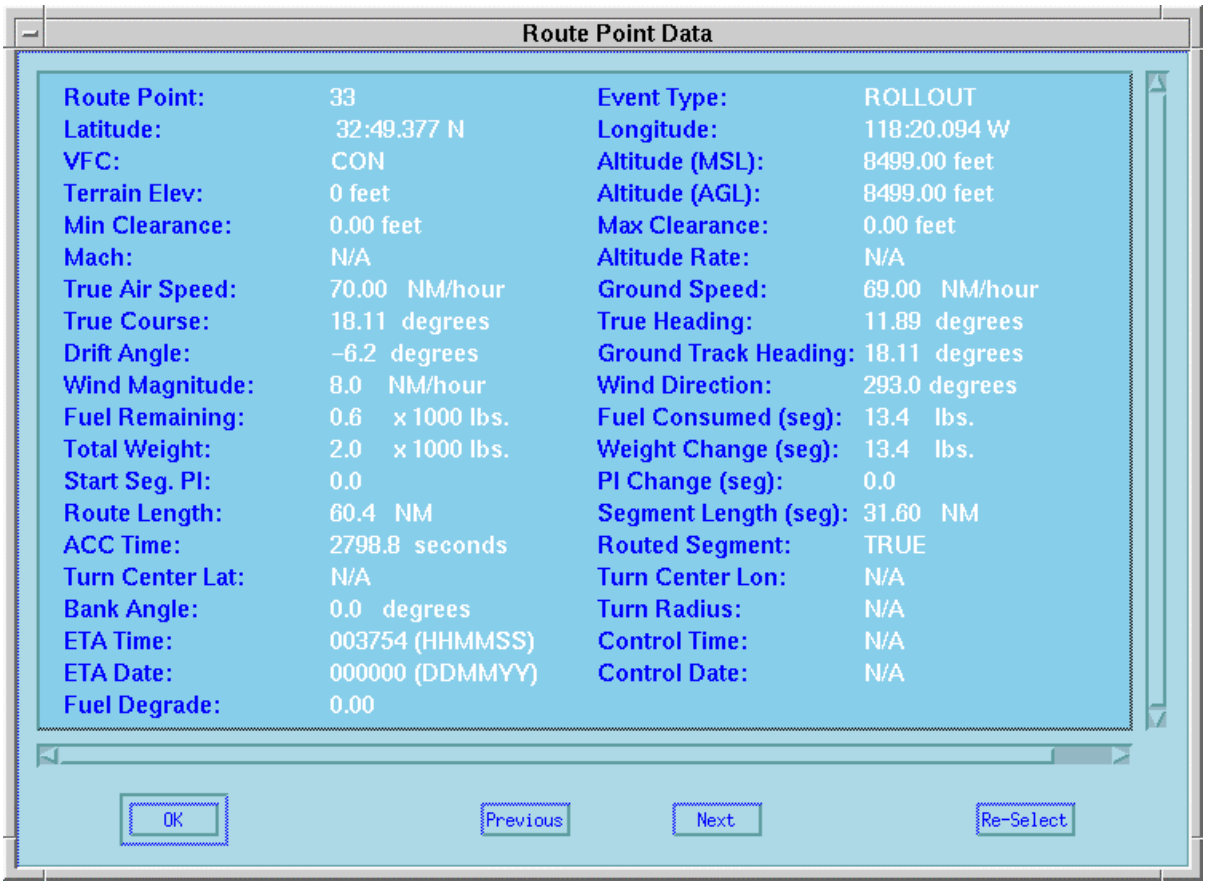

Figure 4.7.1.1-1

4.7.1.2 Execution. The user is required to designate a route point before selecting Route Data to be executed. An information window will appear in the drawing area with the requested data for the referenced point. If more information is available than can be displayed in one window, the window will be equipped with scrollbars.

In addition, there are controls for advancing or retreating the reference point along the route of flight. The controls will automatically refresh the information window without re-executing the Information function. The controls are Previous, Next, and Re-Select. The “Previous” button refreshes the window with data one point from the active reference point up-track towards the launch point. The “Next” button advances the reference point one point from the active reference point down-track towards the landing point. The “Re-Select” button refreshes the information window with data for a new reference point designated by the user. Re-Select assumes the new reference point has already been designated.

4.7.1.3 Results. Route point data is displayed in a window. To exit the dialog, the user selects the “OK” button.

4.7.2 Exposure Data.

4.7.2.1 Purpose. The Exposure Data information window, Figure 4.7.2.1-1, defines the threat exposures for the segment out of the reference point. The Exposure Data dialog is labeled with the reference point’s route point number. The threat data consists of a two line

entry for each site that detects the aircraft along the designated segment. The first row of site data includes the 20 character threat identifier, site latitude (dd:mm.mmm h), latitude at which exposure begins (dd:mm.mmm h), latitude at which exposure ends (dd:mm.mmm h), aircraft MSL altitude when exposure begins (feet), aircraft MSL altitude when exposure ends (feet), aircraft heading when exposure begins (degrees), aircraft heading when exposure ends (degrees), total accumulated flight time when exposure begins (seconds), total accumulated flight time when exposure ends (seconds), duration of exposure (seconds), effective weight of the site (effectiveness remaining percentage), and penalty weight of site's threat type. The second row of site data includes the site's 3 character threat mnemonic, the site's threat type index, site longitude (ddd:mm.mmm h), longitude at which exposure begins (ddd:mm.mmm h), and the longitude at which exposure ends (ddd:mm.mmm h). The threat data information is sorted by threat database index number.

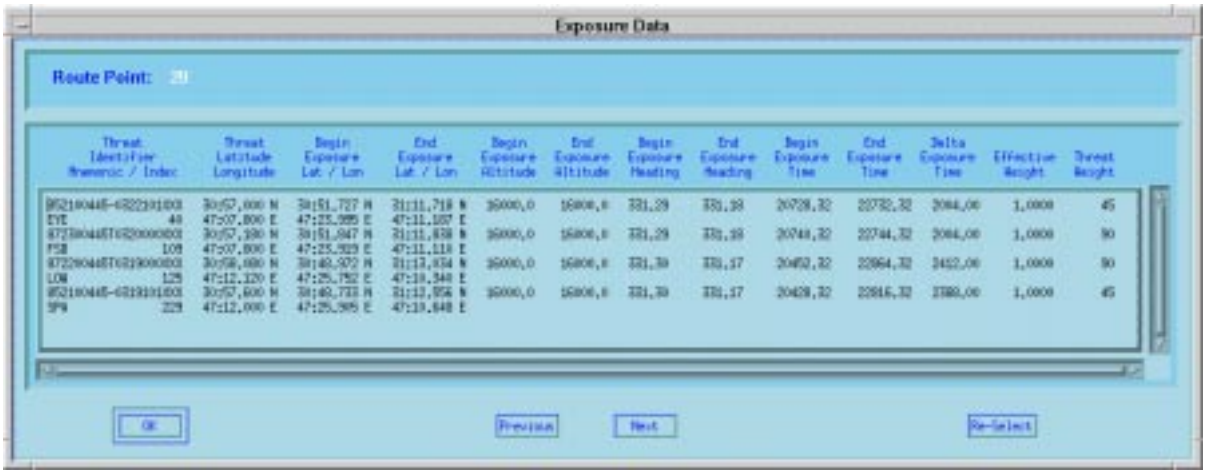

Figure 4.7.2.1-1

4.7.2.2 Execution. The user is required to designate a route point before selecting Route Data to be executed. An information window will appear in the drawing area with the requested data for the referenced point. If more information is available than can be displayed in one window, the window will be equipped with scrollbars. If there are no threats along the segment, the window will be empty. In addition, there are controls for advancing or retreating the reference point along the route of flight. The controls will automatically refresh the information window without re-executing the Information function. The controls are Previous, Next, and Re-Select.

The "Previous" button refreshes the window with data one point from the active reference point up-track towards the Launch Point. The "Next" button advances the reference point one point from the active reference point down-track towards the Landing Point. The "Re-Select" button refreshes the information window with data for a new reference point designated by the user. Re-Select assumes the new reference point has already been designated.

4.7.2.3 Results. Threat exposure at points along the route is displayed in a window. To exit the dialog, the user selects the "OK" button.

4.7.3 Image Data.

4.7.3.1 Purpose. The Image Data information window, Figure 4.7.3.1-1, allows the user to display information concerning a point with payload imaging. The Imaging Data dialog is labeled with the reference point's route point number. The image data consists of the image priority, sensor type, collection elevation and the route point location.

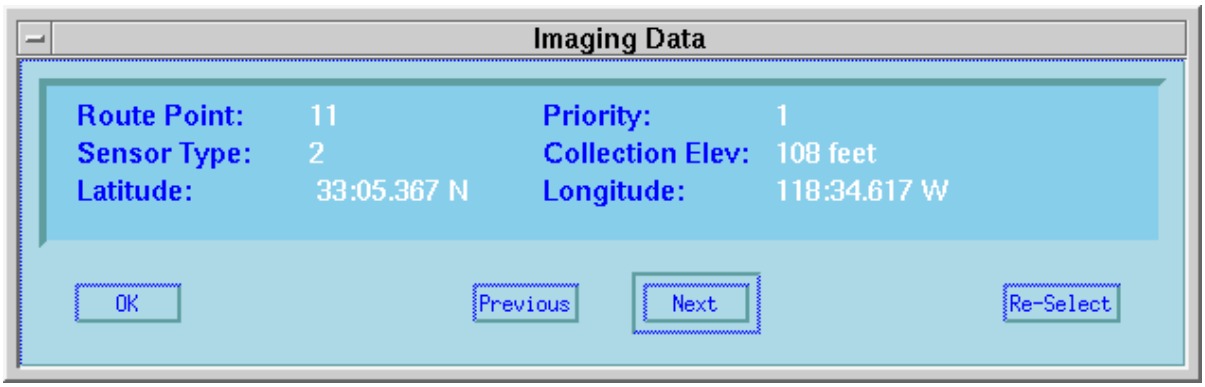

Figure 4.7.3.1-1

4.7.3.2 Execution. The user is required to designate a route point before selecting Route Data to be executed. An information window will appear in the drawing area with the image data for the referenced point. If the point is not an image point the values will be "N/A".

There are controls for advancing or retreating the reference point along the route of flight. The controls will automatically refresh the information window without re-executing the Information function. The controls are Previous, Next, and Re-Select. The "Previous" button refreshes the window with data one point from the active reference point up-track towards the launch point. The "Next" button advances the reference point one point from the active reference point down-track towards the landing point. The "Re-Select" button refreshes the information window with data for a new reference point designated by the user. Re-Select assumes the new reference point has already been designated.

4.7.3.3 Results. The image data for a payload point is displayed in a window. To exit the dialog, the user selects the "OK" button.

4.7.4 Geographic Point Information

4.7.4.1 Purpose. This option displays geographic, threat and target information for a point on the drawing area.

4.7.4.2 Execution. After selecting this information option a message prompts the user to select a map location using the left mouse button, or cancel the request with the <Escape> key. When the point is designated, the Geographic Point Information dialog, Figure 4.7.4.2-1 is displayed. The dialog has three sections. The top section is point information consisting of latitude, longitude, elevation, and the range about the point for which threat and target information were retrieved. The range is automatically set at approximately 1.5% of the zoom's width distance.

The middle section of the dialog contains threat data within the informational range specified in the point information section. This section is scrollable and contains each threat's threat index number, type, function, equipment type, latitude, longitude, elevation, effectiveness remaining, and penalty weight.

The bottom section of the dialog contains a scrollable list of targets within the informational range specified in the point information section. For each target, the list provides target ID, weapon type if assigned to the active sortie, number of weapons assigned from the active sortie, target latitude, target longitude, and target elevation. The "Re-Select" button refreshes the information window with data for a new reference point designated by the user. Re-Select assumes the new reference point has already been designated.

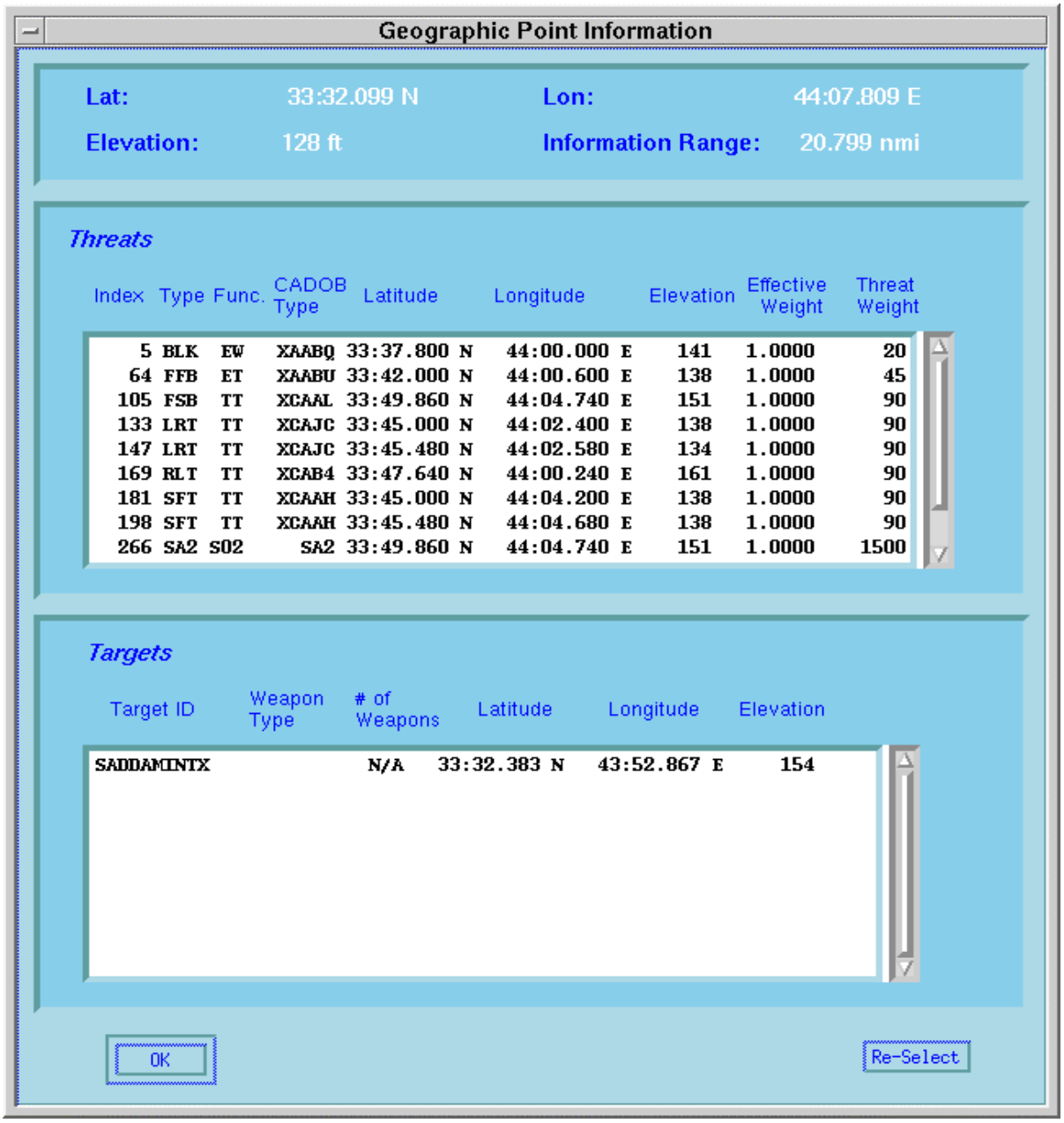

Figure 4.7.4.2-1

4.7.4.3 Results. Information about a selected point on the drawing area is displayed to the user. The information window is closed when the user selects the “OK” button.

4.8 Reports Pull-down Menu

Reports allow the user to generate and display detailed information about specific areas of interest for a route planning session. Selection of the Reports option displays a pull-down menu, Figure 4.8-1, with four different reports. After selecting a report for generation and display, a Report Generation panel appears to inform the user that the report is being created. When the report generation is complete, the Report Generation panel is replaced with the actual report. The reports are displayed on scrollable windows. The windows themselves can be expanded or repositioned.

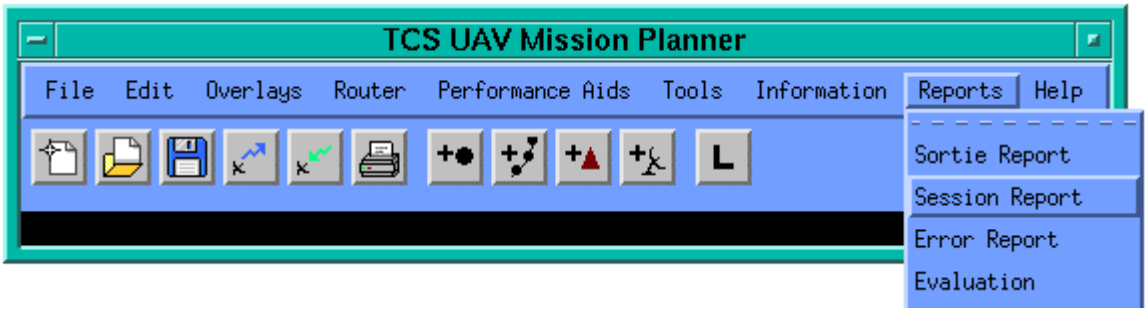

Figure 4.8-1

4.8.1 Sortie Report

4.8.1.1 Purpose. The Sortie Report provides flight plan information specific to the active route. Also, the report has header data defining the planning options, target information, and threat exposure information.

4.8.1.2 Execution. To generate the route flight plan, execute the Sortie Report function on the Reports pull-down menu. The flight plan dialog is displayed with the active route information.

The Options section details sortie options, planning corridor options, exposure options, and supporting databases used to generate the sortie’s Route Data Structure. Sortie options consist of two error levels, sortie and segment, that control the router. Planning corridor options control the three dimensional area that can be used by the router to find a minimum penalty path between mandatory points. The three dimensions consist of maximum aircraft altitude, corridor width either side of center line, and corridor pad before the initial point and beyond the final point. The supporting threat, control, footprint, wind, and tie-up databases used by the Planner are reported for reference.

The Flight Plan Header details the launch data and constituency weights that make up the initial aircraft gross weight. The constituency weights consist of no fuel operating weight, miscellaneous weight, payload weight, and fuel weight.

Segment data, Figure 4.8.1.2-1, follows the flight plan header. Segment data begins at the launch point and contains route point data, segment data, and cumulative data. Point data consists of latitude, longitude, and route point ID. Segment data, like heading, altitude, and airspeed define the route of flight into the point. Cumulative data (fuel, gross weight, time enroute, and distance) defines total route costs up to the referenced route point.

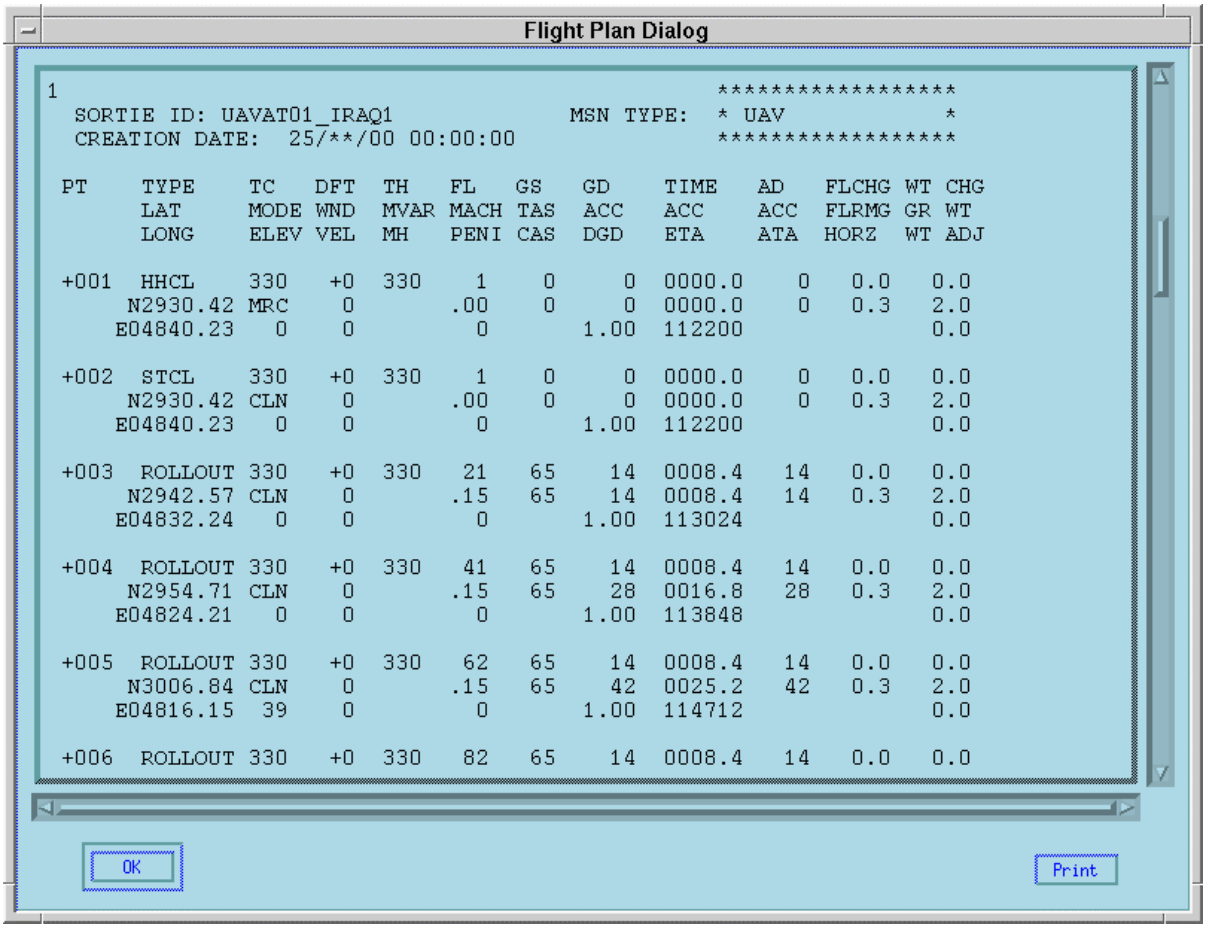

Figure 4.8.1.2-1

The Target Summary is displayed after the route segment data. The Target Summary lists pertinent information about each target imaged during the sortie. The information consists of the target ID, location, elevation, and comments.

Exposure data by site and by threat type follows the target summary. The Site Exposure summary lists, in decreasing order, the sites most lethal to the sortie. Lethality is measured in PI which is the product of exposure duration, threat type penalty weight, and site effectiveness remaining. The threat site summary ranks individual threats by PI contribution to the sorties' overall PI. For each site, the site's threat database index and threat type are followed by threat location, total seconds of exposure, and total PI contribution.

The Type Exposure summary lists, in decreasing order, the threat types most lethal to the sortie. Lethality is accumulated for all sites of a specific type along the entire route of flight. The threat type summary ranks threat types by PI contribution to the sorties' overall PI. For

each type, the type number and type name is followed by total seconds of exposure, total PI contribution, percent of total PI, and percent of total radar PI.

The user may select the “Print” button to generate a hard copy of the sortie report, or select the “OK” button to close the dialog without printing.

4.8.1.3 Results. After executing the Sortie Report function, a report of the route points, targets imaged, and threat exposure is generated and displayed in a scrolled window. A hard copy of the report is generated by the default printer when the report “Print” button is selected.

4.8.2 Session Report

4.8.2.1. Purpose. The Reports menu, Session Report function contains error messages accumulated for the session. These messages deal with the Mission Planner or operating system and are not specific to the active route.

4.8.2.2 Execution. To generate the report of session errors execute the Session Report function on the Reports pull-down menu. The Session Error Report is displayed within a window.

4.8.2.3 Results. After executing the Session Report function, a dialog is displayed with information containing this session’s errors. The user may select the “Print” button to generate a hard copy of the sortie report, or select the “OK” button to close the dialog without printing.

4.8.3 Error Report.

4.8.3.1 Purpose. The Reports menu, Error Report function allows the user to examine the active route planning errors by route point.

4.8.3.2 Execution. To determine the errors which exist in the route plan, execute the Error Report function on the Reports pull-down menu. The Error Report dialog, Figure 4.8.3.2-1 will be displayed. The dialog contains a list of route errors, by route point number, and a description of the error.

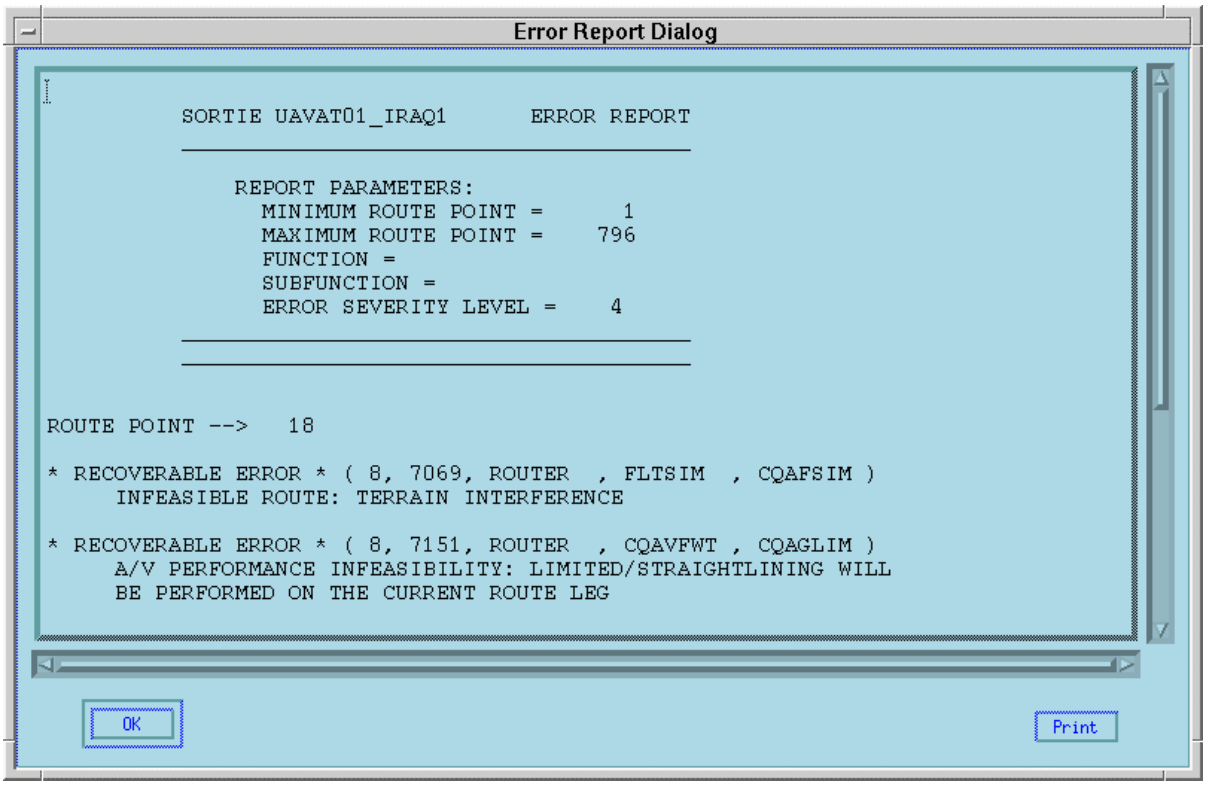

Figure 4.8.3.2-1

4.8.3.3 Results. After executing the Error Report function, a dialog is displayed with information containing the active route's errors. The user may select the "Print" button to generate a hard copy of the sortie report, or select the "OK" button to close the dialog without printing.

4.8.4 Evaluation Report

4.8.4.1 Purpose. The Reports menu, Evaluation function allows the user to summarize the quality of the route related to threats and route distance.

4.8.4.2 Execution. To generate the route summaries, execute the Evaluation function on the Reports pull-down menu. The Evaluator Route Report dialog is displayed.

The first summary displayed in the scrolled dialog is the Raw Exposure Report Summary. This summary contains the raw exposure data from the exposure analysis. It consists of information regarding each exposure's start and stop times, the start and stop route locations, and the threat type and location causing the exposure.

The second summary, Track History, is the product of merged track logic within the evaluator. It reflects the combination of raw exposure data from multiple sites across segment boundaries when the individual sites are netted together. The history shows probability of survival for each track, as well as a cumulative probability of survival for all previous tracks.

The last summary is contained in the Route Expansion Report. Route expansion is the product of the evaluator's range growth logic. It reflects the ratio of routed distance over straight line distance.

The user may select the "Print" button to generate a hard copy of the report, or select the "OK" button to close the dialog without printing.

4.8.4.3 Results. After executing the Evaluation function, three summaries of the route, threat raw exposure, threat track history, and route expansion, are created and displayed in a scrolled window. A hard copy of the report is generated by the default printer when the report "Print" button is selected.

4.9 Help Menu

The File menu, Help function allows the user to determine the version of the UAV TCS Mission planner.

5. ABBREVIATIONS AND ACRONYMS.

AAA	Anti-Aircraft Artillery
AGL	Above Ground Level
AV	Air Vehicle
AWACS	Airborne Warning and Control System
COE	Common Operating Environment
CON	Constant Altitude Cruise
Corr.	Corridor
CSCI	Computer Software Configuration Item
DOB	Defensive Order of Battle
deg.	Degree
DTED	Digitized Terrain Elevation Data
EO	Electro-Optical
ETA	Estimated Time of Arrival
EW	Early Warning
FOR	Field of Regard
FOV	Field of View
ft.	Feet
FVR	Finalize Vertical Route
GDT	Ground Data Terminal
GPS	Global Positioning System
gln.	Gallon
GUI	Graphic User Interface
hr.	Hour
ID	Identifier
IFF	Identification Friend or Foe
IR	Infrared
JMTK	Joint Mapping Tool Kit
kHz	kilohertz
Knts.	Knots
LAT	Latitude
Lat/Lon	Latitude/Longitude
lbs.	Pounds
LO	Low Observable
LOS	Line of Sight
LON	Longitude
LOW	Low Altitude
Max.	Maximum
MB	Megabytes
MGRS	Military Grid Reference System
Min.	minimum
MSL	Mean Sea Level
N/A	Not Available
NM	Nautical Mile
PI	Penetration Index

Planner	UAV TCS Mission Planner
RDS	Route Data Structure
Rte.	Route
SAM	Surface to Air Missile
SAR	Synthetic Aperture Radar
SATCOM	Satellite Communication
SCW	Sensor Coverage Wedge
SUM	Software User's Manual
TA	Target Acquisition
TBD	To Be Determined
TCS	Tactical Control System
Trrn.	Terrain
UAV	Unmanned Air Vehicle
UHF	Ultra High Frequency
UTM	Universal Transverse Mercator
VCR	Video Cassette Recorder
VFC	Vertical Flight Condition
Wght	Weight
Wid	Width
3D	Three Dimensional

6. INDEX.